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THE EXPANSION OF THE ARABLE AREA

C. J. Robertson

It has been said that the most significant geographical boundary is that between the cultivated and the uncultivated land. This might be debated but at any rate its truth for a large part of the world is suggested by the fact that the 1,332 million hectares of arable land reported by the Food and Agriculture Organisation for 1953 (or nearest available year) accounted for only 9·9 per cent. of the total land area.

Some European Antecedents

Without going back into the archaeological record or to other continents, the historians have demonstrated from European evidence since Roman times the slow and fluctuating character of the spread of cultivation. Growth of the arable area appears to have been accelerated in lowland Britain [1] and in Germany [2] under the Romans, with considerable return to forest in the latter on their departure. In Germany [3] some of this lost arable was reclaimed in the early Middle Ages by monasteries, but the attack on the virgin forest was not renewed till Carolingian times. In England, according to Darby,[4] there was "considerable progress" in clearing between the fifth and eleventh centuries. Koebner [5] sees no evidence in Germany, Northern France or England that population pressure was the impulse to clearing and considers that the need of the knightly class in the twelfth and thirteenth centuries for greater income was a more significant factor. He traces [6] the spread of cultivation in the twelfth century eastward and southward into Pomerania, Silesia, Poland, Moravia and Transylvania. In England and Wales, according to Stamp,[7] there was probably no 'waste' left by the fourteenth century and 'stints' had to be introduced in common pasture grazing in the following century. According to Stamp's diagram,[8] arable land increased in England and Wales between 1600 and 1880 by over 1¼ million acres each fifty years.

In the various parts of Europe the choice of areas for clearing probably depended partly on cultivability and soil fertility and the

rate would also be affected by type of plough and adequacy of agricultural techniques in general. The sandy soils and the heavy clays long remained under forest while the medium or loamy soils were cleared. As numbers of livestock rose and pressure for grazing increased—for example, in England in the sixteenth to eighteenth centuries,[9]—they became both economically and ecologically [10] the most active agents in the gradual erosion of the forest area. The process is seen to-day in the northern central hardwood regions of North America, where both repeated cutting-over and overgrazing are destroying the forest.

The Rate of Growth, 1870-1950

Even for Europe the systematic collection of agricultural statistics on an internationally comparable basis did not begin until the foundation of the International Institute of Agriculture in 1905. Examination of the earlier International Yearbooks of Agricultural Statistics shows how difficult was the task of securing data, comparable in definition and for the same year, from the different countries. With World War I and its aftermath there were added increasing difficulties through changing political boundaries. In the following table the present writer has taken for 1910 the data for the nearest available year as published by the Institute and, to allow for boundary changes, has frequently found it necessary to make very rough calculations in order to secure a series of comparable national figures on a 1950 basis. For the European total as a whole, however, the essential element is the subtraction of territories lost to the U.S.S.R. and in this connection very useful tables have been published in the *Yearbook of Food and Agricultural Statistics* by the F.A.O., though in some cases only figures for individual crops and not for total arable area lost are given. Making a very rough total for 1910 or the nearest available year, the figure for Europe is 145 million hectares, which is practically the same as the total for 1939 (146 million) and not very different from that for 1950 or nearest year (148 million).

Between 1870 and 1910 the area brought into cultivation in North America, Australia and mid-latitude Latin America was about 100 million hectares. This gives, in forty years of rapid expansion in overseas mid-latitude lands, an average of 2½ million hectares a year. Adding the probable expansion in the same period in the present territories of the Soviet Union, possibly 60 million, we have a mid-latitude total of roughly 160 million hectares or over 12 per cent of the present world total of cultivated land. In the following forty years, 1910-1950, the overseas lands added another 60 million, their annual rate of increase being thus reduced to 1½ million hectares. Meanwhile another 65 million would appear to have been added in the present territories of the U.S.S.R., so that in the second forty-year period the mid-latitude lands were responsible for roughly another 10 per cent of the present world total. Thus, in the Extra-European mid-latitude lands, both overseas and in the present Soviet territory—the zones in which the greatest expansion of settlement has been going on—the

addition to the cultivated area in the eighty years has been well over a fifth of the present (1955) world total.

EXPANSION OF THE ARABLE AREA 1870-1950
(million hectares)

	1870	1910	1950
United States	77	141	166
Canada	7	20	39
Argentina	—	19	30
Uruguay	—	1	2
Chile	—	1	4
Australia	1	5	8
Total six overseas mid-latitude lands	85	187	249
U.S.S.R.	102	160	225
Total countries of recent expansion	187	347	474
Europe	(140)	145	148
Total of these countries, accounting in 1953 for 48 per cent of the world total	327	492	622

SOURCES OF ABOVE TABLE

U.S.A. *Statistical Abstract of the United States.* Excludes " cropland used for pasture " ; as the variation in actually cultivated land is under study it seems more appropriate to include only " cropland harvested, failed or lying idle or fallow ". This also enables the series to be carried back to 1870, the separation of " plowable pasture " from the general figure for pasture having been begun only in 1920.

Canada. *Canada Yearbook.* The only figure given includes all " improved land ".

Australia. *Yearbook of the Commonwealth of Australia.* This figure does not include " artificially sown grasses ".

U.S.S.R. For 1870, only 46 governments of European Russia (see James Mavor : *An Economic History of Russia,* 1914, Vol. 2, page 282). For 1910, only 63 governments in European Russia, 28 in Asia.

Europe. The figure for 1870 is conjectural.

Other data for 1910 are calculated from the *International Yearbook of Agricultural Statistics* (Rome, International Institute of Agriculture) and those for 1950 are taken from the *Yearbook of Food and Agricultural Statistics* (Rome, Food and Agriculture Organization of the United Nations).

In the mid-latitude countries for which statistics have been given and which account for almost half of the world's present cultivated area, there was an overall increase of roughly 90 per cent in the cultivated area between 1870 and 1950. Conjectural elements in some of the earlier data, even if in error, would not alter the general order of the totals. For most of the other half of the present-day cultivated area figures for 1870 can only be conjectural. But ' conjectures ' resulted in practically the same rate of increase. It can be said that in 1870-1950 there were three main zones of expansion : 1. the overseas mid-latitude countries of recent settlement ; 2. Siberia and other regions of Russian settlement ; 3. tropical and Mediterranean Africa, under the stimulus of security and opening of export markets.

Between 1870 and 1920 the greatest part of the change was in the overseas mid-latitude lands. Until the Revolution Russia probably came next but the data are less complete and open to more difficulty in interpretation. Even in 1882, according to Pavlovsky,[11] 80 per cent of the suitable land in the steppes had already been brought under cultivation ; by 1910-11, according to Volin,[12] settlement was going on mainly in the non-blacksoil areas.

Since 1920 the greatest expansion has been in the U.S.S.R. The post-revolutionary expansion of the pre-World War I arable area has to a great degree been made possible by tractorisation : this reduced the number of work-animals and so enabled arable to be extended largely at the expense of permanent meadow and pasture, otherwise necessary in the absence, under the three-course system, of rotation grass to provide feed.[13] A comparable situation lasted in Sweden [14] until the middle of the nineteenth century. By 1933-37 new land in the non-blacksoil zones was being brought into cultivation at the rate of about 700,000 hectares a year,[15] mainly by cutting down forest, especially in the smaller woodlands. In the north and centre crops are taken two years in three but in Kazakhstan, according to Jasny,[16] at least 41 million hectares are semi-desert, cultivable only sporadically unless irrigated, much being cropped only one year in two or three. In the thirties, expansion on to the semi-arid steppe was proving precarious.[17] Although, according to Jasny,[18] there were 224 million hectares of arable in 1934 (the same figure as given by F.A.O. for 1939 and for 1947), only 135 million (or 60 per cent) were actually harvested in the last years before World War II. The middle fifties have seen a great drive to bring more virgin as well as more fallow land under crops. According to the Central Board of Statistics [19] the total increase in cultivated area for the two years 1954 and 1955 was 29 million hectares, and this, added to the 1947 figure of 224 million hectares, the latest given in the 1954 edition of the F.A.O. Yearbook, would give a total of over 250 million hectares. It was stated in 1955 that work done by M.T.S. tractors on *kolkhozi* had more than doubled, while mechanisation of ploughing on fallow land had also about doubled.[20] On available information it is difficult to understand the figure of 600 million hectares total agricultural area for 1955, but possibly the definition of agricultural area has been changed. Recent visitors to the U.S.S.R. report [21] much wastage of land and manpower on the older farms existing contemporaneously with a critical shortage of manpower in the new areas—Siberia and Kazakhstan. Wastage of land, however, is also the impression of many visitors in the United States.

Elsewhere there appears to have been little expansion of the cultivated area. Even in the overseas countries of recent settlement the arable area seems to have been stabilised. In Canada the area under wheat has stood around 10 million hectares for twenty years. In Australia the arable area has remained at 8 to 10 million hectares (little over 1 per cent of the total area) since 1929. India has shown no appreciable increase in the net sown area in the first half of the century, the great multi-purpose projects, as well as numerous minor irrigation works, having been planned to serve already cultivated areas. As for

China, there was, according to a League of Nations estimate,[22] only 1 per cent increase between 1873 and 1933.

In the tropical forest, notably in Belgian Congo and in West Africa, much of the actual expansion has consisted in the substitution of economically desirable tree-crops such as oil palm and cacao for the natural forest. Where clearings have been made for annual crops, two or three years cropping requires ten to twelve years bush fallow.[23] While the expansion of industrial crops such as oilseeds and cotton was proceeding in Africa and Latin America, the more speculative plantation crops like sugar-cane, coffee, tea and rubber were bringing still more tropical areas into cultivation. In the inter-war years, too, a great pioneer-farming movement was taking place in Cochinchina and Cambodia.

More recently, since World War II, a striking increase in the area under the main crops, amounting to 9½ million hectares between 1934-1938 and 1952, has taken place in the Middle East. This amounted to about 700,000 hectares, or about 2 per cent increase per annum, and these figures should be doubled to include fallow.

The Agro-forestal Frontier

Having examined briefly the rate of growth in the cultivated area in the period since 1870, we may now consider the character of its frontiers to-day. The agro-forestal and agro-pastoral frontiers or, in Kuhnhotz-Lordat's more inclusive term, the agro-silvo-pastoral equilibrium,[24] is the resultant of many factors, physical and cultural. Size of population, the general balance of the economy, market relations, climate, slope, soil are among the obvious elements in the complex. These elements, notably the economic, are far from being static. The equilibrium is thus an instable one and will move in accordance with the relative values per unit of cultivated area, forest or pasture.

The indeterminate character of the agro-forestal frontier over a wide belt may be seen in the form of shifting cultivation in much of the subsistence agriculture of tropical lands, as in Africa, Latin America and some parts of the Monsoon Lands. In contrasting conditions a long-period rotation of forest, cultivation and pasture appears in the eastern and southern United States, where, it is estimated,[25] some 150 million acres have reverted to forest and been recleared one or more times. This rotation has become more rapid in the last three decades with the introduction of power machinery.

Finland is an example of a more stable equilibrium being reached, 'forest-with-clearings' having become, according to Mead,[26] the balance between pressure of farmer settlers and relatively high values of timber. In addition to the general communal demand, the farmer himself requires timber for building and fuel and possibly to provide a dowry for his daughter. This applies to other parts of the northern coniferous zone, especially to Sweden.[27] In Norway scarcity of labour is said to be a further factor favouring forest and there, too, the value attached to forest land is said to have lowered the farmers' own estimates of potentially tillable land.[28]

In France cultivation has, since the latter part of the eighteenth century, actually lost ground to forestry, which has increased its share of the developed area from 15 to 24 per cent. Here we have declining pressure of rural population, facilitating within the country the satisfaction of increasing demands for timber.

The spread of scientific agriculture and forestry brings not only improved techniques but better appreciation of appropriate land-use. In Germany, according to von Dietze,[29] there has been conversion of poor alder woodlands on wet land into meadow for hay, while marginal land on sandy moorlands and hillsides has been taken over by forestry.

The Agro-pastoral Frontier

While the agro-forestal frontier is in many countries, both mid-latitude and tropical, characterised by island-clearings in the forest or islands of forest left in the cultivated zone, the agro-pastoral frontier is rather one of fluctuating advance and retreat along a more or less continuous front. More than the agro-forestal frontier, too, the agro-pastoral frontier is a sociological one. While forest-farmers or farmer-foresters are common on the edge of the northern forest and the tropical peasant may alternate for his main livelihood from field-crops to tree-crops and from, say, rice to rubber or from subsistence root and tuber growing to oil palm, the boundary between the steppe and the sown is, in a wider sense, one between two ways of life, that of the nomad or shepherd and that of the cultivator, sedentary even when his cultivation is ' shifting cultivation '. A striking example of the retreat of the sown before the steppe is instanced by Garnett [30] in regard to the development of the arid *puszta* in the mid-Danubian basin in the sixteenth and seventeenth centuries through the advance of pastoral people.

On the agro-pastoral frontier a series of years when rain comes in sufficient quantity and at the right time tempts the farmer to advance across the critical boundary of annual and seasonal reliability. Sometimes, too, insufficiently skilled farmers advance into territory where techniques of dry-farming, fertilisers or crop varieties they do not possess are needed. The result too often is subsequent deterioration of soil conditions equivalent to an advance of semi-arid climate and a gain of the less delicately adjusted grazing activity at the expense of cultivation.

Although on another economic plane, the dramatic reversal, with decline of the cultivated area and rise of permanent grass, that occurred in Britain after 1880 may be mentioned here as an instance of intensification of economic development accompanied by both higher unit-yields in agriculture and a widening base of national income. More recently, in the United States alternate and more profitable sources of income have resulted in poorer land going out of cultivation or even being completely abandoned. In recent years about one-fifth of the total ' ploughable land ' or ' crop land ' has been used for pasture.

In the purely agricultural aspect the United States offered for a time the spectacle of cultivation moving westward to the accompani-

ment of decline in the east, as quicker or greater profits could be made on the western lands. Another and agriculturally opposite tendency has been noted in Canada,[31] where for a time the new cereal lands in the west replaced older and more developed lands in the east where the local market enabled rotations with less cereals to flourish; at the same time, the advance of the cereal belt could be accompanied by a net decline in the country's total cereal area.

The Tripartite Ratio

Without intensive regional study interpretation of the statistical data of land utilisation by countries for the three main categories of arable, permanent grass and forest can only be highly generalised. This is particularly true for the pastoral aspect, since the statistics for permanent meadow and pasture have a less precise meaning than those for arable and forest and there is less uniformity in their definition as between the various national statistics. The rough grazing of the Scottish Highlands, for instance, is included in the F.A.O. tables as equivalent to permanent meadow. Much 'forest' and much 'waste', too, are also used in most countries for grazing.

Comparison of the tripartite land use in the different countries is attempted in the accompanying diagrams (Figs. 1a. and 1b.), for which the percentages have been calculated from the 1954 edition of the *Yearbook of Food and Agriculture Statistics*, taking for the purpose the figures of arable, permanent meadows and pastures, forest and unused but potentially productive land, and excluding "built-on area, waste-land and other". In most countries the three principal categories complete the total, so that all can be read from the triangle but in countries where there is a category of "unused but potentially productive land", this has been included with permanent meadow and pasture, its character in most cases probably coming nearest to grazing land.

A segregation of the countries into fairly well-marked categories would seem to emerge from the diagrams. In Europe (Fig. 1a.) the 'agrarian' group, with over half the productive area under arable, includes Denmark, Hungary, Poland, Italy, Eastern Germany and Bulgaria. Denmark has built up an economy based on the livestock products of its arable land, on which food crops have been largely replaced by feed crops. The other members of this group, however, are countries in which this high arable is still largely under cereals for food.

The 'forestal' group, with over half the productive area under forest, consists of the three northern countries, in which climate and terrain give the comparative advantage to timber production.

The 'pastoral' group is more varied, largely because of the very different values, ranging from rough mountain grazing to very rich meadow, assembled under the term 'permanent meadow and pasture'. In both the United Kingdom and Ireland conditions, both physical and economic, peculiarly favourable to grassland account for the relatively low percentages of forest in both countries and of arable in

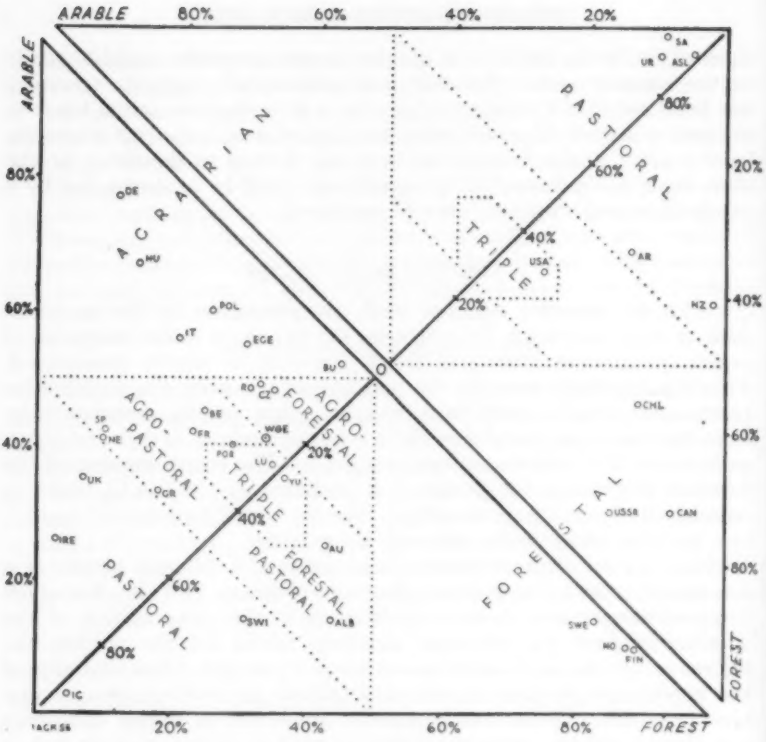

Fig. 1*a*. Utilisation of the productive land area in mid-latitude countries.

In Figures 1*a*. and 1*b*. percentages of arable and of forest are measured along the respective outer sides of the triangles, percentages of permanent pasture and meadow (including unused productive area, if any) along the verticals from O. All percentages are in relation to total productive land area (excluding built-on, waste, etc.). Data based on country totals cover up great regional divergences within most countries but have nevertheless a broad indicative value in regard to the national economies of the respective countries. Countries are grouped as agrarian, forestal, or pastoral if they have over 50 per cent of their productive area in one of these categories. Countries classified as 'triple' have no less than 26 per cent and no more than 40 per cent of their productive area in any one category.

In Figure 1*a*. European countries are in the bottom left triangle, mid-latitude countries of recent settlement in the top right triangle. In Figure 1*b*. countries of Monsoon Asia and the Middle East are in the bottom left triangle, those of Africa, Latin America and the Pacific Islands in the top right triangle.

The list of abbreviations for names of countries (other than U.K., U.S.A. and U.S.S.R.) on p. 9 refers to both diagrams.

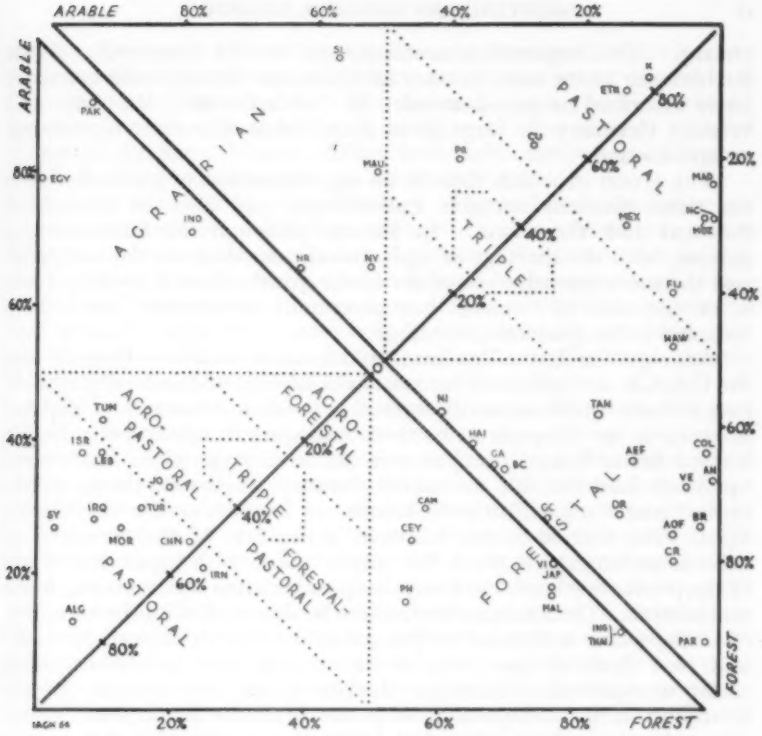

Fig. 1*b*. Utilisation of the productive land area in rest of world.

AEF	French Equatorial Africa	FIN	Finland	NI	Nigeria
ALB	Albania	FR	France	NO	Norway
ALG	Algeria	GA	Gambia	NR	Northern Rhodesia
AN	Angola	GC	Gold Coast	NY	Nyasaland
AOF	French West Africa	GR	Greece	NZ	New Zealand
AR	Argentina	HAI	Haiti	PAK	Pakistan
ASL	Australia	HAW	Hawaii	PAR	Paraguay
AU	Austria	HU	Hungary	PE	Peru
BC	Belgian Congo	IC	Iceland	PH	Philippines
BE	Belgium	IND	India	POL	Poland
BR	Brazil	INS	Indonesia	POR	Portugal
BU	Bulgaria	IRE	Ireland	PR	Puerto Rico
CAM	Cambodia	IRN	Iran	RO	Romania
CAN	Canada	IRQ	Iraq	SA	Union of South Africa
CEY	Ceylon	ISR	Israel	SL	Sierre Leone
CHL	Chile	IT	Italy	SP	Spain
CHN	China	JAP	Japan	SWE	Sweden
COL	Colombia	JO	Jordan	SWI	Switzerland
CR	Costa Rica	K	Kenya	SY	Syria
CU	Cuba	LEB	Lebanon	TAN	Tanganyika
CZ	Czechoslovakia	LU	Luxembourg	THA	Thailand
DE	Denmark	MAD	Madagascar	TUN	Tunisia
DR	Dominican Republic	MAL	Malaya	TUR	Turkey
EGE	Eastern Germany	MAU	Mauritius	UR	Uruguay
EGY	Egypt	MEX	Mexico	VE	Venezuela
ETH	Ethiopia	MOR	French Morocco	VI	Vietnam
FIJ	Fiji	MOZ	Mozambique	WGE	Western Germany
		NC	New Caledonia	YU	Yugoslavia
		NE	Netherlands		

Ireland. This imprecision accounts, too, for the appearance of the Netherlands in the same bracket as Spain and Greece, both countries justly described as agro-pastoral. In Czechoslovakia, Romania and Western Germany the large areas of upland lead to their appearance as agro-forestal.

The group in which there is an approximation to parity between the three divisions contains Luxembourg and also the contrasted Portugal and Yugoslavia. In France, although the forest area is gaining, with the shortage of agricultural manpower on the one hand and the more intensive use of the better grassland on the other, there is 11 per cent of ' unused but potentially productive ' land, here included in the pastoral percentage.

Amongst the Extra-European mid-latitude countries Canada and the U.S.S.R. are still—and for reasons of climate and soil will probably long remain—predominantly forestal ; Sweden, Norway and Finland are seen in the diagram to be their analogues in this respect. In the United States [32] land occupance is still at a stage when forest takes up much land suitable for arable farming—in the northern, north-central and Pacific Northwest forests—or for pasture—in the Middle West. The United States, however, is the first of the countries of ' recent settlement ' to reach the ' triple ' stage, with tripartite division of the productive land into fairly comparable areas under arable, forest and pasture. The southern hemisphere lands are all, with the exception of Chile, which is forestal, in the pastoral segment, though Australia and New Zealand come near to having half their productive areas under non-pastoral utilisation. Iceland is the only country in the European sector comparable with the southern hemisphere super-pastoral group. Switzerland has a very close analogue in Argentina.

Inspection of the tripartite ratios for the rest of the world (Fig. 1*b*.) shows most of Latin America, Monsoon Asia except India and Pakistan, and much of tropical Africa in the forestal segment. The Middle East, Pacific islands, Mexico and Cuba are found in the pastoral segment. For India doubts have been expressed both by agricultural economists and geographers as to the value of the ' other uncultivated ' or ' potentially productive ' land. Taking Spate's estimate that one-ninth of it is possible cultivable land, and eliminating the officially classified ' not available ' as well, we get a figure of 71 per cent as the arable proportion (against 61 per cent if only the official ' not available ' is eliminated). Either of these figures, in fact, place India very high in the ' agrarian ' sector. This great clearance is thought [33] to have been accelerated under Muslim rule, the country having been mainly forested in earlier Hindu times. In a number of monsoon countries, including Japan, such extensive clearance is prevented, despite population pressure, by the high proportion of mountainous terrain.

The demographic relationship is complex and no very clear correlation with arable percentage emerges. Considering in the first place, density of agricultural population on arable area, we find that relatively high arable percentages are met with in countries of high density (Poland, Italy, Bulgaria, Romania) but also in countries of low

density (Denmark, Czechoslovakia, Eastern Germany), where greater technical efficiency operates. Medium arable percentage is found both in countries of high density (Yugoslavia, Ireland, the Netherlands, Greece, Belgium, Portugal) and in those of low density (United Kingdom, France). In some of these both higher agricultural efficiency and wider industrial outlets no doubt operate.

Results from taking the percentage of agricultural population are similarly inconclusive. A high percentage of arable is found in countries (Hungary, Poland, Italy, Eastern Germany, Bulgaria) with a high percentage of agricultural population but still higher percentage arable occurs in Denmark, which has only 28 per cent of its population agricultural. This may, however, be explained by the high productivity per man in a country depending on agricultural exports. The group of industrialised countries, with from 6 to 28 per cent population agricultural (United Kingdom, the Netherlands, Belgium, Western Germany, France, Czechoslovakia), has 35 to 48 per cent of arable. This ties up with the factors making for higher agricultural efficiency in industrialised countries. Greece and Ireland have higher proportions of agricultural population than might be expected from their proportions of arable but, for different reasons, they have a high dependence on grazing. The group with 10 to 12 per cent arable (the northern countries and Switzerland) has anything from 10 to 34 per cent of its population agricultural. In this group, too, especially in Norway, the climate and edaphic conditions over much of the area are unfavourable for agriculture; indeed, in the last twenty-five years pasture has extended at the expense of forest.[34] In these countries, where many farmers derive considerable income from patches of forest inside their holdings, the cultivated area could probably be expanded were it practicable to substitute equivalent sources of income outside the farm area.

If we limit ourselves to the less industrialised countries—in which at least 20 per cent of the population is dependent on agriculture—we find that there is a rough correlation between percentage arable and density of total population (Fig. 2). In Europe the more divergent countries—Austria, Switzerland, Portugal, Greece—are those in which grazing land plays a large part in the agricultural set-up. A similar analysis of tropical and subtropical countries differentiates two series: 1. African and Middle Eastern countries, in which the arable percentage is high relative to the population density; 2. Monsoon Asian and Latin American countries, in which population density is high relative to arable percentage.

Dynamics of Advance and Retreat

The general rate of growth of the cultivated area and the present status of the tripartite ratio have been briefly outlined. Both the agro-forestal and the agro-pastoral frontiers are in instable equilibrium and some indication may now be given of the factors that have to be taken into account in regional analysis of fluctuation in these frontiers. In both cases fluctuations have been seen to depend on population

pressures, relative price levels, relative unit-yields and the balance of exploitation and conservation; all of these are in turn related to general trends in the economy as a whole, whether demographic, technological or commercial. Thus the advance or retreat, expansion or consolidation of the frontier of cultivation in a particular region is more or less dependent on overall factors in general economic development both in the national economy and in the world economy. Arable farming must compete not only with other forms of land utilisation but with other sectors of the economy for manpower, for water and, increasingly in a number of countries, for general subsidisation from the national income.

On the most general plane, a factor of far-reaching effect is the terms of trade for agricultural products, both as against, say, manufactured goods and as between various categories of agricultural commodities themselves. The expansion or shrinkage of demand for particular products, sometimes compartmentalised in particular regions, was a factor in the change of emphasis from the immediate post-World War II urge to expand agricultural production generally to the more cautious policy of gearing agricultural expansion to market demand.[35] In recent years the relatively unfavourable trade position of cotton led, in the Middle East, to extension of the area under food crops. In Turkey particularly the difficulties in marketing industrial crops, relatively sensitive to price fluctuations, the insecurity of foreign markets, high transport costs and quality requirements, led to increased wheat production and, for a number of years, the building-up of wheat stocks. The switching from one crop to another need not be on a particular farm; expansion in one region may compensate in the national economy for shrinkage in another. This would be more apparent on a time-series of land utilisation maps. On a wider plane discussions in Australia since World War II on the proper emphasis of economic development as between primary and secondary production have illustrated the bearing of general trading conditions and the financial risks of changing terms of trade to the economy of the country on the rate of agricultural expansion.

The advance of the frontier of cultivation involves, on the one hand, the costs of land reclamation, varying with the character of the terrain, soil and vegetation and with the capital equipment and labour available; on the other hand, there have to be taken into account the costs of providing housing, supplies of energy, lines of transportation and communication to open up markets and enable cheaper supplies and facilities to reach the farmer. An example of failure of general facilities to catch up with economic potentialities, a situation especially liable to occur in underdeveloped countries, was the lack of transport to remove marketable groundnuts in Nigeria. The efforts of the Syrian Government to provide adequate transport [36] for the Euphrates and Jezireh development areas [37] are another case in point. With rising standards of welfare in most parts of the world, the much higher costs of the social services expected by the new settler of to-day have proved one of the most significant decelerators of areal expansion since World War II.

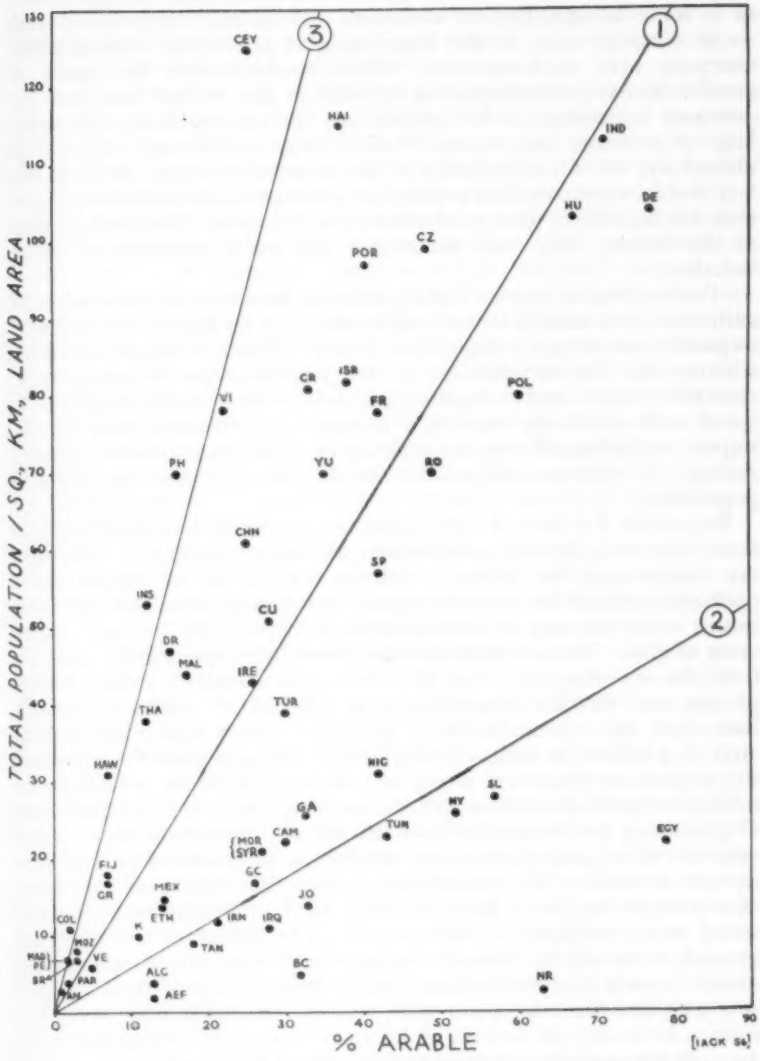

Fig. 2. Total population in relation to percentage arable area.

Total population is referred to, and percentage of arable is calculated on productive land area as defined in Figure 1. The countries fall into three principal 'trend' types : 1. Less industrialised Europe ; 2. Middle East and Africa ; 3. Monsoon Asia and Latin America.

Expansion of the cultivated area may be hindered, too, by ill-adapted land tenures and an unprogressive social structure generally, as in some Middle Eastern countries. There may be political and social obstacles also to the large scale of operations economically necessary with mechanisation. While mechanisation has made it possible to carry out operations speedily at the critical time and for one man to manage, as in Canada, 240 hectares or more, with some help at seedtime and harvest,[38] there may be political and social obstacles to the full exploitation of this technical advance, not least the fact that in some countries population pressure makes productivity per man less significant than productivity per unit area. Full exploitation of the former, too, may accentuate the social problems of rural isolation.

Particularly in regions lacking mineral resources the expansion of cultivated area may be stimulated by the need for agricultural exports to pay for investment capital from abroad. This is a critical problem, whether for industrialisation or for improvement of agriculture, especially where costly irrigation works have to be constructed. The speed with which the expansion proceeds may depend, too, on the import and eventually on the training of technical personnel and the raising of general educational levels amongst the agricultural population.

Retreating frontiers of cultivation are especially well-illustrated in many regions by the area under wheat, so often a pioneer crop. Farmers are discouraged by relatively adverse conditions of production—optimism induced by unusually good years having been checked by a return to the average or even to years drier than the average—or by years of glut. Thus in Australia the wheat belt is perceptibly moving from the dry marginal areas to better rainfall country, where clover pasture and fertility improvement is possible ;[39] while unit-yields have risen, the area under the crop shrank from 7 million hectares in 1931 to 4 million in 1952. In Canada the Department of Agriculture has proposed a long-term policy of reducing the wheat area from 10 million to 8 million hectares. In Europe, too, the Food and Agriculture Organisation had suggested that the hill and mountain areas could contract their grain production and switch to extensive animal production or timber. British agriculture after 1880 illustrates the retreat of wheat-growing from marginal land, with interruptions in the two world wars, especially in the second. The extent of the marginal ground is shown by Stamp's calculation[40] that the proportion of arable to total land use in Great Britain could be raised from the pre-war 22·5 per cent to 34 per cent, i.e., to over 19 million acres (7·7 million hectares), an increase of 7,600,000 acres (3·1 million hectares). In 1948, the post-war maximum, arable area actually rose to 17,400,000 acres (7 million hectares). Since then it has declined.

The Potential Arable Area

A very frequently quoted estimate of the world's potential arable is that made by Salter,[41] which would indicate the possibility of raising

the total by another 520 million hectares to 13·6 per cent of the land area. It is interesting to compare this with Fawcett's [42] 30 per cent, a very rough estimate based on climate and on applying to the rest of the world, after eliminating cold and hot deserts, a rough average of Europe, India-Pakistan and the United States.

Salter arrived at his estimate of 360 million hectares for South America and Africa and 40 million for Southern Asia by assuming that 20 per cent of the unused tropical soils, mainly equatorial, would be free from the disadvantage of a long dry season that is a feature of the savanna lands. Similarly, he assumes that no more than 10 per cent of the unused podzols in North America and the U.S.S.R., mainly in the former, can be brought into the picture. While he thus makes allowance for unfavourable climate—which Prasolov's estimates of soil types suitable for cultivation ignore [43]—neither he nor Prasolov consider inaccessibility. On the other hand he does not include the Middle East, where the Food and Agriculture Organisation estimates 71 million hectares potential arable, which would raise his total to 591 million hectares and so the world total, actual and potential to 1923 million, just over 14 per cent of the land area, or just under 14 per cent if the increase in actual cultivated area since Salter made his estimates is deducted from his potential. We may conclude that an optimistic estimate of possible future expansion would increase present cultivated area by about 40 per cent.

When actual estimates of cultivable potentials for individual countries are considered, it is seen that Salter's indicative figures are very generous. Many of these areas prove, on closer examination, to be, in Vogt's term,[44] " ecologically vulnerable ", in particular to soil erosion. The probability of large parts of these areas, however great their physical potential, being brought into cultivation is doubtful. The contrast between the farthest crop limits, which have been greatly extended through the introduction of new varieties and the possibilities of speeding-up operations by mechanisation, and the frontier of cultivation, whether continuous or of the ' island ' type frequent in the northern coniferous forest and in Latin America, emphasizes the fact that practical limits are not physical but economic.

There has been general agreement among recent writers on the prospects of world agricultural development (for instance Salter, Kellogg, Stamp, Cressey [45]) that the most promising zones for increased agricultural production, especially through intensification, are those of middle latitudes. Where inadequate moisture is the limiting factor it may be countered by irrigation, dry-farming techniques or suitable crop varieties; otherwise the land that remains is more likely to be suitable for pasture.

The estimates [46] of possible sources of additional cultivated land in the United States, a total of 72 million hectares, in themselves make up the major part of the total for North America and the U.S.S.R. as estimated by Salter. They are as follows, in million hectares :

Ploughed-up pasture .	40	Drained . .	8
Cleared . . .	16	Irrigated . .	8

According to Wooten, if recent trends of population continue for the next twenty-five years, half of the above estimate for ploughed-up pasture would be carried out and 10 million hectares of the estimate for clearing. In the cut-over areas of the Lake States the better situated land—about 15 per cent—would probably be brought into cultivation and some gains are also probable in the eastern States. Elsewhere extension is only likely where there is still fertile land near centres of population (in the northern third of Michigan, Minnesota and Wisconsin).[47] The work in hand for irrigation, including that on the Missouri, Columbia and Colorado Rivers and in the Central Valley of California, is expected to increase the 11 million hectares irrigated in 1950 by over 50 per cent.

Estimates for Canada [48] vary from 18 to 40 million hectares; averaging this at 30 million, taking the larger U.N.S.C.C.U.R. estimate of 72 million for the United States and older estimates of 20 million for the U.S.S.R. gives a total of just over 170 million hectares, agreeing with Salter's total for North America and the U.S.S.R. In Canada, however, as we have seen, the area under wheat has been stable for twenty years and there is little ground for assuming any increase in the next twenty years. On the other hand, official Russian sources indicate expansion of sown land at 15 million hectares a year in the last two years.[49] Thus, while the expansion in Canada is perhaps slower than formerly expected, that in the U.S.S.R. is, according to official data, much more rapid. The greatest irrigation projects outside India are in the U.S.S.R., too, where works to irrigate over 8 million hectares have been reported under construction and still larger projects were envisaged. Russian agricultural policy, however, has in recent years shown drastic changes in priorities to meet current needs.

In Australia Duggan [50] considers 59 million hectares (7 to 8 per cent of the total area) the total suitable for cultivation. This includes the 8 to 10 million already cultivated and the area needed for pasture by existing farms. Scope for expansion is mainly in the south-west of Western Australia and in the better rainfall districts of Queensland and Northern Australia. But much of the total 'suitable' area does not have reliable rains. Experts are now more inclined to favour the development of reliable rainfall areas by channeling effort into greater control of fungal diseases,[51] as in Canada, rather than regaining land in the unreliable rainfall areas.

As for Africa and Latin America, Russell [52] quotes estimates of 16 million hectares for Southern Rhodesia, 4 million for the Union of South Africa, 19 million for Chile and 11 million for Peru.

For China as a whole Buck estimated a possible extension of 15 million hectares. In North and Central China water conservancy and control projects, especially in the valleys of the Hwai and the Hwang, may add about 4 million hectares [53] to the cultivated area. Figures up to 30 million (including 8 million for the Hwang valley) have been quoted [54] for 1970 in long-term plans but in the 1952-57 plan priority has been given to industrial projects. The most likely frontier of expansion is still thought to be in Northern Manchuria, where it is estimated that

8 to 12 million hectares[55] might be placed under wheat with dry-farming techniques, though with only low unit-yields and in bad years little or nothing. The remainder of Buck's 15 million, on the still drier margins of Northern Manchuria, is now considered to be unlikely.

Alongside some of the above figures the data published by E.C.A.F.E.[56] for areas that were to be brought into cultivation between 1952-53 and 1956-57 seem modest. Amongst these countries India takes the leading place, with 3·7 million hectares, and is followed by Pakistan (1·3), Thailand (0·2) and Ceylon (0·1). Russell considers that in India possibly another 8 to 10 million hectares in all could be brought into cultivation. The extension of dry-farming offers considerable possibilities not only in the Middle East (particularly in Syria, Turkey and Iraq) but in parts of the Monsoon lands, notably the 'dry zone' of Ceylon, where it is estimated that it would double the country's present cultivated area of 1·5 million hectares. There is also much potential unirrigated cropland in the Philippines, Indonesia, Malaya and Burma.

The problem presented by the system of continued alternation of cereals and fallow on the semi-arid margins, whether in the United States, the U.S.S.R., China, Australia or Africa, is loss of nitrogen and organic matter, without the possibility of replacement by the farm-yard and green manure available in humid climates. No leguminous crop is yet known that will grow in semi-arid regions and have the same beneficial effects in the farm economy and in particular on the soil as clover has in the moister regions.[57] The introduction of suitable green fodder crops is the basis of mixed husbandry, reducing the need for fallow and so enabling an extension of sown area and a reduction in the liability to soil erosion.

Irrigation and Drainage Projects

Examination of the data for areas for which water is available but unutilised shows that Monsoon Asia, which at present possesses three-fifths to three-quarters of the world's irrigated land, with its many great rivers, has still the greatest possibilities. These are located, however, where they would intensify cropping in the existing cultivated area rather than extend the latter.

These possibilities of higher unit-yields are especially great in India, where 80 per cent of the cultivated area depends on the monsoon, which fails one year in five. It is estimated that merely to maintain present low levels of food consumption irrigation facilities for 5 million hectares are needed in ten years, as an alternative to bringing a further 13 million hectares under cultivation or otherwise increasing unit-yields by 15 per cent.[58] Projects for completion by 1956-57 or by 1960 in India will irrigate 7·5 million hectares, mostly already cultivated. It was reported[59] in January 1955 that major schemes had by then provided 1·1 million hectares of new irrigated land, while improved facilities in the shape of tube-wells and tanks in existing irrigated areas had benefited another 1·7 million hectares. Some published estimates[60] give eventual increases of 30 to 40 million hectares. Much of the

' cultivable waste ' is probably more suitable for afforestation than for agriculture, and considerable caution is needed.[61]

Other irrigation projects for completion by 1956-57 would cover in Pakistan 1·2 million hectares by that date and 2 to 2·5 million eventually (mainly the Lower Sind and Lloyd barrages), and 850,000 hectares and eventually 2·1 million (mainly from the higher Aswan dam, which would not begin to have effect until 1966-67).

Altogether, something between 33 and 40 million hectares would be irrigated by present projects. The world's irrigated area in 1953 or nearest year, as recorded by F.A.O., was 103 million hectares, so that these works would approximately increase it by 30 to 40 per cent. The greater part of the additional production by this means would be by more intensive cropping in the existing cultivated areas, whether by higher unit-yields or by double and even triple cropping.

Along with the bringing-in of water at the right place and time must be considered the other hydrographic problem of removing unwanted water and thereby reclaiming large areas of waterlogged and saline lands. This has notable possibilities in West Pakistan, where, in Punjab and Sind, 37 per cent of the cultivated area is waterlogged and 21 per cent is badly affected by salinity and where, in the Indus basin, drainage would, together with irrigation, add 8 million hectares (equivalent to the present irrigated area) to the arable land.[62] Iraq, too, has large drainage projects, including the Twairig scheme, which would cope with 1·2 million hectares.

Conclusions

In the eighty years, 1870-1950, there was something like a 90 per cent increase of the area cultivated in the countries for which longer records are available. Summation of conjectural estimates for the rest of the world has given an increase of a similar order, though very irregularly distributed among the individual countries. Estimates of further extension of the cultivated area, mainly in dry-farming zones, in the near future are of modest proportions, except in the areas covered by Russian official statistics. Even if world estimates are based only on soil and climatic possibilities, ignoring relative costs, it seems that the present arable area might be increased by about half, while estimates published in a number of countries in connection with their own national projects, or as the result of unofficial investigations, arrive only at an increase by about a quarter, and some of these probably err on the side of optimism.

Agricultural production is still predominantly on family farms and, with the impossibility or at least difficulty of amassing capital, the individual farmer has not in the great majority of cases, the equipment, the technical background or the financial cover to improve new land and to meet new risks, whether physical or economic. Over large areas, too, he lacks adequate facilities for transportation of his product to market and for obtaining supplies or spare parts for new equipment. Even Governments, with massive modern methods at their disposal, find it more economic to improve existing areas by providing security to encourage the farmers, on the second plane, to increase their yields.

than to take over areas in need of complete reclamation and now frequently what is left after all the easily developed land has been occupied.

The more promising line of development is thus generally intensification of yields. The possibilities, whether of extension of the cultivated area or of intensification must be considered in the context of general economic development. Available methods of producing more from the existing cultivated land are not yet known to vast sections of the world's agricultural population, especially in Africa, Monsoon Asia, the Middle East and Latin America. This is not merely a matter of making capital equipment available but is largely a human problem of communicating ideas, of introducing technical and managerial skill in the regions where the absence of these factors is the cause of low productivity. This is the only dynamic policy toward continuing welfare on a world scale.

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CLIMATIC OBSERVATIONS IN SCOTLAND

CYRIL A. HALSTEAD

GEOGRAPHERS are to a considerable extent dependent on the observations of others for the material they attempt to weave into a web of cause and effect. When such material is lacking or deficient, the geographer himself must make the observations. This is exemplified in problems of landforms, soils, development of settlement patterns or movements of people to markets and the like.

In the case of climate the problem might at first sight seem to be that of reducing the great mass of observational material to manageable proportions. On closer inspection, however, it becomes apparent that there are considerable gaps in our knowledge which not only diminish the value of geographical syntheses but hinder the formation of important decisions on land use and the development of other natural resources. This is clearly reflected in the attempts being made by the Nature Conservancy to study climatic conditions in Wester Ross, the Cairngorms or the Ben Lawers area in recent years by means of summer observations undertaken by scouts and schoolboys. In *Weather*, 1955, Volume 10, pp. 41-48, it is admitted that very little is likely to be discovered with existing methods about the length of the period of growth on the important hill grazings of much of the country. Such problems as the economic balance between forestry and grazing can not truly be solved until information about wind strength and its relation to tree heights and forest yields have been studied. Similarly much expense is incurred by hydro-electric engineers who are usually obliged to establish their own rain gauges. Even so, they will have no information about the amounts of snow blown from one catchment area to another ; indeed, only a small amount of snow will actually be caught in such gauges.

That such lack of information affects not only upland areas may be seen from the accompanying map (Fig. 1). Here are shown, by counties only, the distribution of both rain gauges and climatological stations throughout the country. Each small circle represents a station making temperature observations and the uneven distribution of these is at once apparent. The absence of such stations from the whole of Strathmore, for example, is striking ; here, no doubt, the proximity of the Highlands has a profound influence—perhaps through shelter or cold air downflow—but exact quantitative data is lacking. Similarly representative stations in Galloway or Easter Ross are hard to find. One of the main reasons for such an uneven spread of stations lies in the concentration of observations in coastal resorts or on airfields—three-fifths of the climatic stations fall in this category. Admittedly the stations making observations several times a day for weather forecasting purposes—the synoptic stations—are best placed in these positions but as a result there is a dearth of information about wind and other factors for inland areas (Fig. 1).

The matter becomes even more critical if the effect of height on climatic factors require to be studied. This may be seen from the

following table which gives the density of climatic stations between various contours in Scotland—the Orkneys, Shetlands and some small islands are omitted :—

Height in feet	Climatic Stations per 1,000 square miles
Above 1,500	0
1,250-1,500	0·03
1,000-1,250	1·7
900-1,000	0·7
800-900	1·9
700-800	1·6
600-700	1·0
500-600	1·0
400-500	2·6
300-400	1·3
200-300	8
100-200	7
0-100	16

The concentration at low altitudes is striking and since three-quarters of Scotland lies above 300 feet and no stations whatever occur above 1,500 feet the average density of 3 per thousand square miles for the whole country has little significance in reality. Much of the land above 500 feet is of economic value and yet exact climatic studies there are difficult and for the country above 1,270 feet (about one-fifth of the total) impossible except for the results of the Ben Nevis Observatory; the latter were in effect voluntary observations which could only be carried on from 1883-1904. However, such a station, almost in the free atmosphere, is probably not truly representative of wide expanses of plateau moorland.

The pattern of rain gauges is much better—about 16 per cent are more than 1,000 feet above sea-level (about 32 per cent of the land is above that height) and four of the 900 are above 2,000 feet.

A further analysis of the climatic stations reveals that four of the five such stations at 1,000 feet or above are run by private individuals or bodies, the fifth depending very much on the willingness of a far-from-well observer. Here there is obviously considerable scope for the keen amateur to make a greater contribution to knowledge than in almost any other field. Those who are able to install their own stations are now fewer than formerly but guaranteed attendance at the hours of observation (9 a.m. and 9 p.m. GMT—the latter only for exposing the grass minimum thermometer) all the year round will greatly interest the Meteorological Office if the prospective observer is in one of the less well-covered areas or height zones.

Until more climatic data is available many geographical problems must remain unsolved and many plans and indeed even some existing industrial installations are liable to suffer through lack of complete knowledge of the climatic conditions.

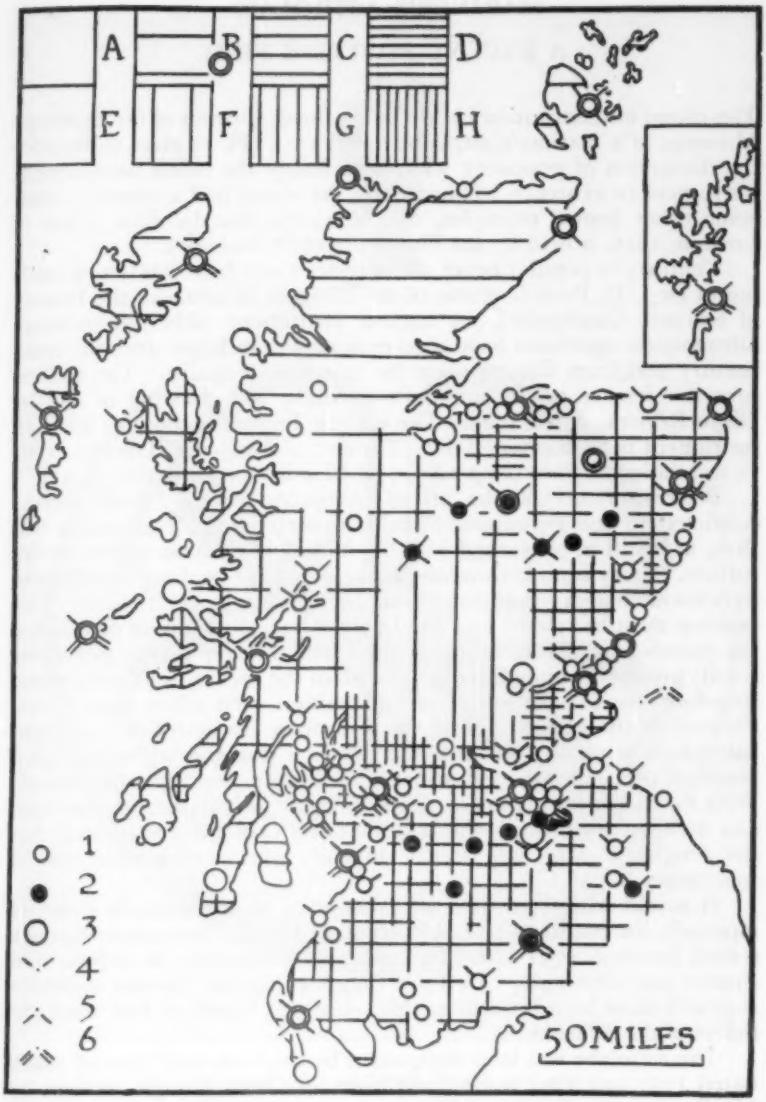


Fig. 1. Distribution of climatological stations and rain gauges, whose data is published, in Scotland, 1955.

SYMBOLS.—1. Climatological stations : 2. Climatological stations over 600 feet above sea-level : 3. Synoptic stations : 4. Stations measuring sunshine : 5. Stations estimating wind : 6. Stations measuring wind.

SHADING.—Density, by counties, of CLIMATOLOGICAL STATIONS : A, less than 1 : B, 1-3 : C, 4-7 : D, 8 or more—per thousand square miles ; of RAIN GAUGES : E, 1 or less : F, 2-3 : G, 4-7 : H, 8 or more—per hundred square miles.

MARINER'S ASTROLABE

A RECENT SCOTTISH FIND

THE recent authentication by Mr James Boyd, Curator of the Dudhope Museum, of a mariner's astrolabe dated 1555 (Pl. 1) gives to Dundee the distinction of possessing what is probably the oldest navigational instrument in existence. It antedates, by about half a century, some seven other known examples, one of which, that by Elias Allen of London, 1616, is held by the University of St Andrew's.

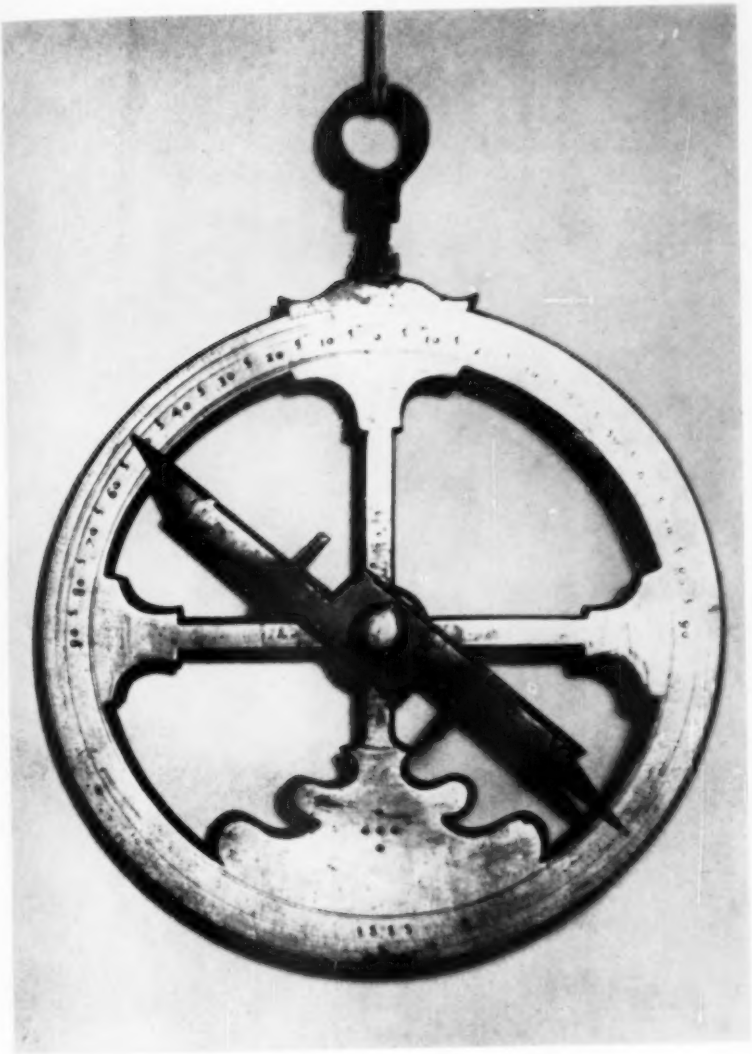
Contrary to popular belief, the mariner's astrolabe was not, according to Dr J. D. Price (Curator of the Whipple Museum of the History of Science, Cambridge), an ancient instrument, although ordinary astronomical astrolabes have been preserved from Islam since the tenth century and from Europe since the thirteenth century. The earliest precise reference to the mariner's astrolabe is a drawing of one by Diego Ribiera, dated 1529. The earliest English account of such an instrument is by Richard Eden, *The Arts of Navigation*, London, 1561 (a translation of *Breve Compendio*—, by Martin Cortes, Seville, 1551).

Before about 1560 the art of navigation was a 'trade secret' restricted to the Portuguese-Spanish expert pilots. Navigation was then, as it still is, concerned with the finding of position on the earth's surface. Away from known landmarks, this must be done by reference to heavenly bodies whose position in the sky must be determined. This position must be related to a fixed datum-line, the simplest of which is the plumb-line. An astrolabe is essentially a heavy metal (sometimes wood) protractor hung from the thumb of the user by a loose ring and therefore free to take up a vertical position even when used at sea. Pivoted on the vertical line of the protractor (its zero line) is a sight rule which is pointed towards the sun or a star and whose end then reads off the angle which that heavenly body makes with the vertical. With the aid of astronomical tables and some calculations the position can then be determined, the latitude fairly easily and accurately but the longitude only with much difficulty and considerable risk of inaccuracy.

It would now seem that the production of an astrolabe designed especially for mariners probably originated in the Portuguese-Spanish school between 1530 and 1550 and was transmitted to Britain and France just after 1560. Dr Price suggests that the Dundee astrolabe may well have been brought to this country as 'spoils of war' after the defeat of the Armada.

The astrolabe was later superseded by the back-staff (two of which dated 1731 and 1754 respectively have also been brought to light by Mr Boyd at the Dudhope Museum), and eventually by the sextant, still in use, both of which use the horizon as a datum line.

We are indebted to Mr J. D. BOYD for permission to publish the photograph of the mariner's astrolabe and to incorporate Dr Price's comments on this instrument.



Pl. 1 (see p. 24). MARINER'S ASTROLABE, 1555

Dudhope Museum, Dundee

diameter	8 inches
weight	6 lb. 6 oz.
thickness of dial	$\frac{5}{8}$ inches
metal	brass

The name Andrew Smyton (? Smeaton) and the date 1688 are inscribed on the back of the astrolabe

Information Service of India, Lo

Pl. 2. COLLECTING COTTON, ANAND, BOMBAY

Collecting cotton at the farm of the Agricultural Institute at Anand, which is making experiments annual American cotton. The woman worker, dressed for the occasion of the photograph, is wearing a sa here it is a quality and an elegance that would normally be reserved only for social and other such occasions. re from t

The cotton plant, an annual shrub, is planted March/April in this region and grows rapidly du ks are t the rainy monsoon period. The bolls (the fruit) continue to ripen and burst from September ing like December revealing the seeds to which the white fluffy cotton fibres are attached. Collection must done by hand as the bolls do not all ripen at the same time on any one plant. The seeds, used for extraction of oil, are separated from the fibres at a cotton gin.

Information Service of India, London.

PL 3. JUTE RETTING AND EXTRACTION, BARRACKPORE, BENGAL

annual, sown in this region April/May, and cut July/August, jute is assembled in a nearby pond
here it is left to ret for at least fourteen days until the plant is soft enough to allow the extraction of the
re from the centre of the stalks. The fibre is then dried in the sun, after which it is sent to market. The
ks are used as kindling fuel for domestic purposes in rural and urban areas. Also, young jute leaves,
ing like and having similar properties to chinchona (quinine) are eaten as a vegetable.

Pl 4 (p. 25). MOUNTAINS OF SOUTHERN GREECE

North of Corinth Canal, looking westwards :

Maturely dissected crystalline highlands (summits *circa* 3,000 feet) enclosing small basins developed on less resistant and closely dissected tertiary deposits (centre right) : typical Mediterranean 'scrub' vegetation of dwarf evergreen oak and juniper, much depleted on high 'bald' hills in background: trees around village (bottom right) and along stream course : cultivation on valley floor and on patches on higher benches (centre left) : isolated trees in latter provide shade for family labour : apart from one unmetalled track (bottom right) only routes are narrow footpaths (bottom centre).

Photograph by Aerofilms Ltd

RE-AFFORESTATION IN GREECE

ANNE PRENTICE

ONCE mainly wooded, Greece has to-day only 14·2 per cent of her total area under forest, and re-afforestation is a problem of national importance. This account begins with a brief assessment of the present distribution of Greek forests in relation to climate and soil, then deals with general problems of re-afforestation. Subsequently the management of forests and techniques of planting are described in relation to specific problems encountered. The article concludes with a brief summary of the progress made in Greece since 1945.

Many factors have contributed to this present lack of forests, and an understanding of these factors and their inter-relationship is necessary before methods of re-afforestation can be studied. A glance at the list of tree species indigenous to Greece, together with the good evidence that Greece was once mainly forested, might suggest that re-afforestation should be an easy task once a start was made. Deforestation has, however, gone too far. Natural regeneration is at present difficult and artificial regeneration must be undertaken everywhere in the country. The geographical environment is not, however, altogether favourable and the basic problems confronting re-afforestation are physical. They in their turn cause human problems, which have been further increased by an historical sequence of foreign domination, frequent fighting and two World Wars.

The objects of re-afforestation in Greece are, firstly, to supply the timber needs of the country, and, secondly, to protect the land and soil; the two aims are reciprocal. Re-afforestation is only one facet of the country's plan for development—one which must go alongside water control and irrigation, land reclamation, the exploitation of other existing resources, and social reform. Fundamentally however, due to a shortage of alternative fuels, the timber needs of Greece are necessarily great. It is estimated that to meet her regular timber requirements Greece must more than quadruple her existing annual output. This gives some idea of the magnitude of the problem.

FOREST AREA AND SPECIES

The total area of Greece is 12,700,000 hectares, of which 18·5 per cent is agricultural land, 14·2 per cent is forest, and 24 per cent is rocky and mountain regions used for grazing; the remaining 43 per cent is largely treeless scrub more or less dense, termed 'chaparral', at present utilised only for grazing (Pl. 4). Of this latter 43 per cent, it is estimated that 20 per cent can be forested, mainly by natural regeneration or less artificial re-afforestation, and 5 per cent can be converted to agriculture. The remaining 18 per cent, a region of poor soil and 'garrigue'—open scrub on limestone land—can only be used for grazing and lime production.

Greek forests fall into two classes—coppice forest and high forest. Coppice comprises 35 per cent of the forest area and is composed of

Photograph by Aerofilms Ltd

evergreen broadleaves such as Dwarf oak, Arbutus, etc. Of the high forest, Aleppo pine (which forms either pure stands or mixed stands with evergreen broadleaves as an under-storey) and deciduous oak each account for 20 per cent of the forest area. Fir covers 12 per cent, beech 6 per cent, and Black pine 3 per cent. The remaining 4 per cent is composed of other species such as elm, ash and juniper. All these species are indigenous to Greece, and most of them are used in re-afforestation. Exotic species such as Acacia, False acacia, Maritime pine, and various poplars, have been introduced.

There is evidence from ancient Greek literature, archaeological studies, place-names and other such data that Greece was once mainly forested. In 1821, at the beginning of the National Revolution, it is estimated that forests covered 40 per cent of the total area. Since that time the forests have been reduced to their present extent of 14·2 per cent. In general, altitude and climate, and to a lesser extent parent material and soil, determined the composition and *original* extent of forests in Greece. In particular, accessibility, exploitation by man, and climate (particularly summer drought) are responsible for their *present* limited extent. The contrast between the less accessible, better-forested mountains, and the plains and lower plateaux is marked (Fig. 1), though the latter may have either an intermittent forest cover or carry chaparral and depleted and degraded forest.

In the mountains of northern Greece, east of the Vardar River, there is still considerable forest. Mainly composed of oak with some beech and a little chestnut, it covers the non-calcareous soil of the Rodopi plateau ; a belt of forest follows the Pelagonic massif and intrusives from Volos northwards to the Yugoslavian frontier.

In the forests of central Greece, fir, economically more valuable than pine, is the main genus. There are only two small regions of Black pine at high altitudes (above 2,000 metres), while Scots pine and spruce grow above the limit of fir elsewhere. Broadleaves flank the central coniferous forest on its lower limit, below 1,500 metres.

Certain areas of continental Greece are notably poor in forests. In western Macedonia there is a large area around Kozani where deforestation has cleared once well-wooded land. Another easily accessible region where chaparral is extensive and forest cover poor is the west coast of continental Greece. The latter, moreover, is one of the most favourable regions for forest growth since rain-bearing south-west winds strike this coast : Arta has an annual rainfall of 42 inches and no summer month is without rain. Also, the annual temperature range is more equable than further east, as a result of the shelter from the Central European air masses afforded by the Pindos range.

In south-eastern Greece (Eubœa, Attica and Peloponnesus) the forest cover is in a very poor condition. Altitude and topography allow greater accessibility, and the extreme climate is a handicap to natural regeneration : Athens has an annual rainfall of 15 inches and together with Kalamata, one month, July, without rain. In Crete and the Aegean islands the situation is even more serious : Canea and Naxos have no rain from June until August, and the lack of soil on the metamorphic rocks of the Cyclades islands is an additional limiting factor.

Fig. 1. Distribution of main types of forest in Greece.

General Problems of Re-afforestation

The most obvious physical disadvantage to re-afforestation is climate. The coincidence of high summer temperatures with the season of drought is unfortunate. This, however, can be overcome by choosing suitable species and adapting planting techniques. A greater

problem is the shortness of the planting season ; the soil is not sufficiently humid until November, and killing frosts occur in December. There is only a six-week planting season in autumn, and another in spring from mid-March until the end of April.

Topography too is an important factor. The large proportion of mountain and the high degree of inaccessibility mean extra work and expense in transporting labour and supplies of young seedlings up to high plantations. Severe sheet and gully erosion is caused by torrential rainfall on steep slopes ; soil-slip and debris washed down from the upper slopes may engulf young plants. Erosion of the easily-weathered Flysch under heavy rainfall is a particular problem on the windward hills of west-continental Greece.

Other problems are related to the soil. Generally shallow and stony, soil may be absent in places ; its small proportion of humus and low nitrogen content is yet another disadvantage. In this case pine, less demanding than fir or oak, is planted first to improve and fix the soil. After one rotation (about 60 to 70 years) the ground can then be replanted with the more demanding and valuable species.

The human problems are a direct result of the over-exploitation of this physical environment. The more that is taken from the land the less it produces : the natural vegetation has been cut, burned, grazed, and then mismanaged by overstocking and by reburning in a desperate attempt to improve its grazing value. Burning not only removes the surface vegetation but continuous firing damages the roots and alters limestone. Torrential rain then removes the unprotected top soil and cakes the unstable subsoil so that it becomes unfit for the germination of seeds. The result is the disappearance of the more desirable species. In this way evergreen oak has disappeared from the granites, gneiss and schists of eastern Greece, leaving poor chaparral and bare rock.

Greece has long been overstocked. Not only are the animals grazed on the surface vegetation but in the oak-forest region branches are cut for fodder. In 1950, in spite of war during the previous ten years, there were over three million goats in Greece. On the basis of one hectare per animal, two million goats is the maximum number for the 1.5 to 2 million hectares which are available as permanent grazing.

There are also practical problems restricting the work of re-afforestation. Lack of money for the construction of dams, roads and other such expensive works is the most outstanding. United States aid in post-war years served the cause of re-afforestation to some extent, but the task is so great that there is still much to be done by Greece herself. Shortage of personnel is another such problem.

Re-afforestation and Planting Problems

The Forest Service is responsible for the entire work of forest management and re-afforestation, and includes special departments for torrent control and mountain-soil conservation. The main work of re-afforestation is planting, though in some places the ground may require considerable preparation. Stones may be removed and the area fenced ; brushwood barrages may be placed at short intervals

along gullies to build up cavities, and in a few cases irrigation systems may be established.

Re-afforestation includes the planting of bare land and along watercourses, roads and fields, and the improvement of existing stands. There are vast areas to be covered with *Pinus brutia* and cypress ; and much of this laborious work of planting is done by women, each armed with a short hoe and a bucket of seedlings. Poplar and some plane trees are used along streams, rivers and lakes, where they serve both to fix the soil and to utilise narrow strips of fertile soil. Poplar and acacia are planted along roads to provide shade, and cypress is largely used as a windbreak and in cemeteries. In some places cypress (*Cupressus sempervirens* var. *pyramidalis*) is traditionally planted at the birth of a child. It is an old but sound custom, whereby the father plants perhaps a hundred trees for his child as an investment for the future.

Most of the forest land belongs to the State, only a small percentage being owned by communities or private individuals. In these latter cases the initiative may come from a town's local authority which applies to the Forest Service for seedlings, and possibly some financial aid ; or it may come from the Forest Service, which suggests to the authority that planting would be beneficial in a certain area, and provides money and seedlings.

Young plants come from nurseries, most of which are situated in the plains and foothills. They cover in total an area of 180 hectares and produce annually 25 to 30 million plants, mainly *Pinus brutia*, poplar, acacia and cypress. For example, three nurseries in Macedonia produce yearly one-and-a-half million poplars, the same number of acacia, and other fast-growing broadleaved species. Cypress nurseries are mainly in central and southern Greece. It is estimated that each year over two million cypress seedlings are distributed free to farmers and village communities besides those used by the Forest Service.

The sowing of seed is generally done on low contour-terraces 5-6 metres wide, a shallow trench being dug on each terrace in November. Poplars are grown from cuttings, saving time and labour, and may reach a height of 10-15 feet in the nurseries. This, however, is a mixed blessing because the tall saplings are difficult and expensive to transport, and require holes over one metre deep when transplanted.

Seedlings stay in the nurseries until they are from 7-12 months old. About 1,500 to 2,000 seedlings are transplanted per hectare. The usual method of planting is in a hole about 30 centimetres in diameter and 35 centimetres deep, earth being packed round the roots of the seedlings but not up to the level of the surrounding ground so that the plant is in a basin which can conserve precious rainwater. Research has shown that this is not everywhere satisfactory, and improvements according to local conditions are necessary. The young plantations are usually fenced, and sometimes guarded against grazing animals by forest guards.

Regional variations from this general practice occur in respect to depth, age and season of planting. In south-eastern Greece and Crete, areas with hot arid summers, the microclimate within the basins is an important factor. It was found, for example, that the basin-like de-

pressions around the planted seedlings cause increased temperatures at the roots of the young plants. Experiments were made to counteract this effect by lining the bottom of the basin with different material—a more costly process—and by using basins of different dimensions. The Forest Service, however, reports that the percentage of success in these regions is low, being 30 to 40 per cent for pine and 35 to 50 per cent for cypress. For this reason certain modifications have been suggested. If there is no other shade a big stone or sod of turf might be placed on the south-west side of the seedling. If it is not possible to plant in the shade irrigation is advised, but this greatly increases the cost. It has also been suggested that planting should be done in suitably orientated furrows rather than basins.

In the mountains of central and northern Greece planting is done in autumn, suspended in winter, and resumed in March after winter damages have been repaired. Seedlings are transplanted at the age of 12 to 24 months, and in this case the soil may be banked to prevent water from collecting round the stem. The percentage of success is higher than in southern Greece, being 50 to 70 per cent for deciduous trees and 50 to 80 per cent for conifers.

The third major region is that of the plains. Here planting begins in late autumn and may continue throughout the winter. The holes are bigger in the deeper soils, being 30 to 40 centimetres deep. The percentage of success is highest in this region, rising, on good soils, to 95 per cent.

In some places yet another technique is being tried. A small area about 0·2 to 0·5 of a hectare is planted with a particular species. Known as a ' nucleus of re-afforestation ' it has every care until well-established, after which it is left to regenerate naturally.

The Present Position and Future Problems

Since the beginning of this century the work of re-afforestation has been continuous, except for the war years. There was a fairly steady increase from an area of 97 hectares forested in the 5-year period 1901-6 to 7,552 hectares in the period 1936-41. After the liberation, planting was resumed, at first at the rate of 360 hectares in 1945-6 ; but by the year 1948-9 planting had, with financial aid from the U.S.A., increased to 3,850 hectares. In that year some two million dollars were used in the re-afforestation programme. The following year aid amounted to over four million dollars, and the area planted increased to 8,742 hectares. By 1950-1, Greece was beginning to recover from ten years of intermittent fighting, and a maximum figure of 11,075 hectares was planted with the aid of less dollars than in the previous year.

Less than 15 per cent of Greece is forested at present and it is hoped to double this figure eventually, 30 per cent being about the total percentage of land which can be re-afforested. It will, however, be many years before the new forests can meet the country's requirements. In 1953 Greece produced 200,000 cubic metres of timber, but she imported a further 356,000 cubic metres together with 55,578 tons of wood (including pulp). Although production in that year was double the pre-war quantity, this was largely due to over-exploitation by the

Forest Service of certain of the country's best forest areas—depleting further her precious capital. A short-term target for the next five years is 300,000 cubic metres. The aesthetic value of re-afforestation is also important. Cutting has, of course, been most drastic in the vicinity of towns and villages where woods could be both pleasant and productive.

Although a start has been made Greece is fully aware of the magnitude of the task ahead. Improvement of her forest resources cannot continue beyond a certain point without development in other departments. Flood control, the exploitation of power from water and lignite and the establishment of industry must accompany modern techniques and scientific investigation. Before Greece can build up timber reserves, an alternative fuel to wood for domestic use particularly, must be developed. In Macedonia, for instance, a large hydro-electric power station has been built near Edessa to supply western Macedonia, and is in part-operation. Lignite, also in western Macedonia, is being exploited, and it is hoped that a chemical industry will be initiated this year. Re-afforestation is only one facet in the future development of Greece.

The problem of re-afforestation and the formation of timber reserves is an arduous and long-term one. Years of over-exploitation and mismanagement of the land have cleared vast areas, and the environment is not altogether favourable to replanting. The main physical problems are climate, inaccessibility, and poverty of soil. Also, as part of a wider plan for the development of the country, re-afforestation must await progress in other departments and cannot be allotted more than its fair share of available funds and labour.

Since 1901, and particularly in the last eight years, progress has been made but, as yet, the area planted is very small—under 1 per cent of the total area. It is, however, a start and the problem is being tackled with increasing vigour and method. Road building and construction, the sowing of seed, transplanting, forest research and the study of wood utilisation are being carried out. The main anxiety for the future must be the time factor. Economic stability is essential. A country as dependent as is Greece on a slow-growing commodity such as timber is at a disadvantage, physically and economically, compared with other more fortunate nations. If re-afforestation can be accelerated and the country's timber imports thus decreased, an important step will have been taken towards the attainment of that economic stability necessary to safeguard her vulnerable position as a gateway to Europe.

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AN EIGHTEENTH-CENTURY GEOGRAPHER WILLIAM GUTHRIE OF BRECHIN

W. Gordon East

Readers of Thackeray's *Vanity Fair* will recall that Miss Pinkerton's academy for young ladies on Chiswick Mall, which had once been honoured by the presence of Dr Johnson, was no ordinary educational establishment. A few casual references in this 'Novel without a Hero' tell us that no less than dancing, music, backboard, embroidery, needlework, literature and French, geography figured in the curriculum of Miss Pinkerton's well-born, or at least, well-to-do, young ladies. When testifying to the many virtues and accomplishments of the gentle Miss Amelia Sedley, on her departure from the academy in 18—, Miss Pinkerton had, however, to admit that "in geography there is still much to be desired." The less favoured though more intelligent and spirited Becky Sharp, who left the academy in Miss Sedley's company uncommended by its principal, was endowed, we learn, with "a vivid imagination; she had, besides, read the *Arabian Nights* and Guthrie's *Geography*."

Our curiosity is aroused by such strange juxtaposition, the more so since we know less than we would wish about the nature, content and teaching of geography in 18—, which were the years immediately before the battle of Waterloo. Was the novelist hitting off an antithesis between the wondrous fables of the east and the sturdy, earthy facts of the geography book? Or—for we are mindful that 18— lies nearly half a century before the emergence of scientific geography—did he account Guthrie's *Geography* no less a work of fiction than the *Arabian Nights*?

If Guthrie's *Geography* is unknown to-day, except to a few students of the history of British geography, there can be no doubt, as references to his work in the major libraries show, that he met the need of many readers during no less than eight decades. The book was first published in London in the year 1770, under the title 'A New System of Modern Geography: Or, a Geographical, Historical, and Commercial Grammar; and Present State of the Several Kingdoms of the World.' It ran through at least thirty editions, which involved corrections, excisions and additions—the revisions of one sort or another that always confront the authors of standard works on current affairs. The book had already lasted over forty years when the inquiring eyes of Becky Sharp, worldly wise already though anxious to know better the world she was to exploit, encountered its numerous pages. Which edition, we may wonder, did she peruse? Was it one of the many octavo editions or one of the pocket editions with tiny print?

While we must give Miss Pinkerton credit for including so substantial and worthy a compendium among the tools of her trade, it seems likely that items of intriguing information contained in earlier editions but excised in later ones, might not have won her approbation. Thus on page 270 of the fourth edition corrected, which was published in 1788, we read about "the matrimonial clubs attributed

to the ancient Britons ", and on page 811, in a section dealing with the recently discovered Friendly Islands, about " a singular piece of luxury " enjoyed by " the great men " : " women sit beside them all night, and beat on different parts of their body until they go to sleep ; after which they [the women] relax a little of their labour, unless they [the men] appear likely to awake ; in which case they [the women] redouble their drumming until they [the men] are again fast asleep ".

William Guthrie, son of an episcopalian clergyman, was born at Brechin, Forfarshire in 1708, educated at the University of Aberdeen and came to London in 1730 to seek his fortune as an author. His literary activities and the power of his pen enabled him to obtain a government pension of £200 a year, and his writings which, said Boswell, had considerable merit, appear considerable, too, in scale. He published translations of the works of Cicero and Quintilian, a four-volume history of England, a ten-volume history of Scotland, a (very inaccurate) *List of the English Peerage*, and *An Essay upon English Tragedy*, while under the pseudonym Jeffrey Broadbottom, he contributed articles (including one on flatulence) to the periodical *Old England*.

Some recorded details about Guthrie show him in an unfavourable light. He is thought to have reviewed very favourably in the *Gentleman's Magazine* one of his own works, and had no scruples in exacting a pension from Tory and Whig governments alike. He finds a niche in Chamber's *Eminent Scotsmen* however, and Dr Johnson's opinion of him, as recorded by Boswell, was relatively favourable : " Sir," said the Doctor, " he [Guthrie] is a man of parts. He has no great fund of knowledge but by reading so long and working so long, he, no doubt, has picked up a good deal ". But our concern is less with the man than with the book for which he is best known—his *Geography*, which first appeared in the year of his death (1770) and reached its last edition in 1843.

Study of Guthrie's original Preface and of the Advertisements which were added to later editions, helps to explain what he set out to do and the success which was certainly achieved. He saw clearly that a new reading public, no longer restricted to students and the rich, had come to exist in Great Britain in the later eighteenth century. This country had become prosperous, important, world-wide in its commercial interests, and interested in new learning : a growing body of ordinary citizens were willing to be instructed by suitably written books. Travellers, Guthrie alleged, were formerly activated by avarice, but had come to thirst for knowledge. In geography Guthrie found and cultivated a field of knowledge at once useful, improving and even entertaining. While, therefore, his compendium bristles with information, it is written with the intent also to maintain the reader's interest and, on occasions, to amuse.

Guthrie was formally concerned with the two main branches of his subject which he called ' Natural Geography ' and ' Moral or Political Geography '. He does not define the former term which has long disappeared from the language of geographers. In Guthrie's use of the term ' natural ', Man is not part of Nature ; ' Natural Geography ' is thus concerned with the earth and its surface as the stage of human activities. It would be misleading to regard it as closely coincident with

'Physical Geography' as now understood, for, writing so long before the science of geology had established its novel explanations of the earth, Guthrie had perforce very little to tell about the physical landscape and no more about the physical geography of the oceans and the atmosphere. "The Science of Natural Geography", he wrote, "still remains in an imperfect state for want of geographical surveys." Indeed, judging from his text, 'Natural Geography' would appear to consist largely of 'mathematical' or 'astronomical' geography, which fills the greater part of his Introduction. This section entitled 'Astronomical Geography' (Part I—some 24 pages) was contributed by James Ferguson, F.R.S. The term 'Moral or Political Geography' appears obscure or even antithetic until one recalls the original derivation of 'moral' from the Latin *mos*—custom. 'Moral or Political Geography' was concerned then with the customs of peoples all over the world. It meant the descriptive geography of mankind and offered Guthrie boundless opportunity to display his learning and to indulge his fancy.

Here indeed was the true *omnium gatherum* geography of pre-scientific days. 'Moral Geography', as a concept, has long lain dead, although its ghost may occasionally smile at the efforts of modern geographers to contain the expansiveness of their scientific interests. 'Political Geography' flourishes as one of the many special aspects of geography, concerned with a circumscribed, yet spacious field of study —the relationships between geography and politics.

Serious attention was given to the map illustration for Guthrie's *Geography*. The first edition was "illustrated by large maps". In some editions these were bound up with the text, while for others they were published separately. Dilly and Robinson, for instance, published in 1785 a *General Atlas* of maps engraved for what they called Guthrie's *New System of Geography*. These, like the texts, were continually revised for successive editions. While inevitably the maps were variously deficient in content and cartography when judged by modern standards, they were successful in showing much with clarity and rough accuracy. The world was depicted in what became the conventional western and eastern hemispheres, and the routes of Captain Cook's recent voyages (1768-80) were drawn. There were maps of the continents, of the principal countries, including the 'United American States' and the commercially valuable West Indies. Coasts, rivers and international boundaries were clearly shown—the latter in colour. Mountains were indicated by hachures; some attempts were made to show forests and deserts. Occasionally canals and shallow waters (as off the West Indian islands) were marked, while for the countries of the British Isles even main highways were given. Lines of latitude and longitude were always shown, and the prime meridian—that vagrant of early cartography—was taken at London, although Greenwich had been used as early as 1738 on certain English charts. These maps must have helped contemporaries to locate countries, towns and ports and other features; they are of interest to us in showing the extent of the knowledge of the late eighteenth century and also the names then attached to the various lands.

It is to modern readers a little odd that Guthrie should have claimed that his work, though compendious, had " narrow bounds ", that elegance had been sacrificed to brevity, and that unlike earlier works (none of which is named in his Preface), his was so reduced in size as to suit the purses of those who were not rich. A little odd, because in some at least of the editions, the book contained no less than 867 octavo pages, 11½ inches long by 8½ inches wide, to which was added the ' Copious Index '. ' A New Geographical Table ', which gave the name and situations of the chief cities, towns, seas, gulfs, bays, straits, capes and other remarkable places, filled sixteen pages, and was followed by ' A Modern Universal Table ; the most copious and authentic that ever was published, of the present state of the real and imaginary monies of the world '. Even the miniature editions, cast in more neat and portable form (e.g. 5¾ inches by 4¼ inches) were usually expanded versions, containing more words than the earlier octavo editions.

A moment's reflection suggests that the vast area of print contained in Guthrie's *Geography* was by no means excessive for a survey of the world, the more so since Guthrie cast his net widely to include the history without which his readers could not examine the present state of nations " with much entertainment or instruction ". With his view that history was relevant to geography present geographers would find themselves in broad agreement, although they would differ from him about the kind of history which is relevant and the uses to which it is put. Inevitably Guthrie was more interested in people than in land, for he was writing in the days before Sir Charles Lyell and even Dr James Hutton. And although, too, he was writing before the advent of scientific history, archaeology and anthropology, he had at his disposal a fund of pseudo-history and a growing volume of travellers' reports, from which to try and compile accurate accounts.

A glance through the index of Guthrie's *Geography*, which, in the fourth edition corrected of 1788, fills twenty-five double-columned pages and runs from Abbeville to Zurich, at once acquaints the reader with the range, wealth and diversity of this successful compilation. Some items immediately attract attention by their oddity in an otherwise sober text. Miss Pinkerton might have frowned a little at " Camels, how taught to dance in Egypt ", at " Mermen and women, in the Norwegian seas, accounts of ", and at " Seraglio of the Turkish emperor, the ladies of, how guarded ", although her respect for Guthrie might have been restored by the note, under ' France ', " Absurd use of paint by the ladies ". But these are exceptional entries. The names of kings and other potentates abound : there are ten Henrys and six Charles ; there are the names of many political, military and religious leaders ; numerous names of countries, islands, cities and other places. Under ' M ', ' Magna Charta ' is listed between Magellan and Mahomet, and under ' D ', Domesday Book between Dog Star and Dominica. Such items as ' Tides ', ' Wind ', ' Maps ', ' Climates ', ' Latitude ', and ' Polar Circles ' recall the reader to Mr Ferguson's introductory pages, while, as befits an age of great mercantile activity, there is more than a sprinkling of references to economic affairs. ' The

Deluge ' and ' Noah's Ark ' appear too, since they play a cardinal role in the historical exposition.

Since descriptive geography, as indeed also the ' regional geography ' of to-day, is very much a matter of literary art, it mirrors the mind of its author as well as his scientific learning. The way in which, seeking to present the world of his day to his readers, Guthrie apportions his space, touches off our interest in many directions. Sheer lack of knowledge accounts for some brevities and omissions ; his very British point of view, his estimate of what his readers wanted to know and his predilection for commerce, discovery and the arts of life—for the higher civilisations in short—help to explain the brief accounts here and the flowing pages there. Of some significance, too, in urging or restraining Guthrie's pen was his measure, as a Christian, of the relative importance of the peoples of the earth, some won over to false creeds, others still sunk in pagan barbarism.

Australian readers of Guthrie's *Geography* could scarcely be surprised to find that their country is described in 1788, under the name ' New Holland ', in a single short paragraph. They would be little amused to find that, under the general heading ' New Discoveries ', New Zealand receives a whole page. The other continents receive very unequal treatment. No less than 528 pages, occupying 70 per cent of the space devoted to ' Political Geography ', are given to Europe, and of these pages the British Isles share nearly one quarter. America—was it not a European discovery and creation ?—comes off relatively well with 114 pages. Asia, despite the many marks of divine favour which it had enjoyed, " offered extremely little for our entertainment and instruction ", and was despatched in 89 pages, of which 26 were allotted to India, an area of British interest on which the reports of the East India Company had thrown much light. Not surprisingly, only 27 pages were given to Africa : " we must acknowledge our ignorance of the bounds, and even the names of several inland nations, which may be still reckoned among the unknown and undiscovered parts of the world ".

Doubtless there can be no exact answer to the question how space should be distributed between the several continents in a text-book on the geography of the world. Clearly the country and continent of the author and his readers will get the lion's share. Clearly, too, the proportional space will and should be different at different points of time, as the human evaluation of land changes. Compare Guthrie's allocation of space with that in two well-known modern text-books by British authors (see Table opposite), and we find that his priorities are still broadly maintained.

In retrospect Guthrie's *Geography* appears a worthy attempt to compile existing knowledge of the world to the ends of which British power and commerce had spread by the late eighteenth century. Neither a work of fiction nor of science as now understood, it presented copious classified information and served clearly an educational purpose. There is plenty of internal evidence to show the efforts which were made by his publishers to secure accuracy and to keep abreast of increasing knowledge. While we are far away from the

PERCENTAGE OF PAGES DEVOTED TO THE CONTINENTS IN :

	Guthrie's *Geography*, Fourth edition, corrected 1788	Newbigin's *A New Regional Geography of the World*, First edition, 1929	Stamp's *The World. A Regional Geography*, First edition, 1929
EUROPE	70	37	41
AMERICA	15	28	17
ASIA	11·5	17	25
AFRICA	3·5	12	10
AUSTRALASIA AND PACIFIC ISLANDS	0·5	6	8

geography of landscape, atmosphere and oceans and from understanding of the genetic relationships between man and land, this is no arid geography of capes and bays. We are made aware in general terms of the sharp contrasts in environments and the markedly different cultural habits and levels in the many parts of the world. Here and there occur passages which interest still. " Maps differ from the globe in the same manner as a picture does from a statue "—this has epigrammatic quality. A graphic contemporary picture is given of how a sugar plantation was set up and operated in the West Indies, and the reader is told (in successive editions) how the price of slaves continued to rise. The accounts of the United States in their early days, as of the Barbary states in their last days of independence, are of some interest too as contemporary appreciations. The table of the money of the world, which gives its value in English equivalents and might appear designed for readers interested in foreign trade and travel, repays perusal. Did we all know that in those days of Britain's greatness the pound sterling (was as it now is) 'imaginary'[1] money, unlike the guinea, but like the *mark* in Brandenburg, the *pistole* in France, and the *lire* in Italian cities?

Guthrie looked forward in his Preface to the time when " geographical science arrives at greater perfection ". With the qualification that perfection is more than enough to strive for, we may share his hope, as also an awareness of its contemporary shortcomings. And it may well be that, when the history of British geography is one day written, Guthrie may find honourable mention, not as an original thinker but at least as a populariser of geography.

[1] A unit of account and not a coin.

THE COTTON AND JUTE INDUSTRIES OF INDIA

A Study in Concentration and Dispersal

William Kirk

Based on a paper read at the International Geographical Union Congress, Washington, 1952.

> For whosoever hath, to him shall be given, and he shall have more abundance: but whosoever hath not, from him shall be taken away even that he hath.
>
> *St Matthew* XIII. 12.

In the changing patterns of man's adjustment to his behavioural environment probably no force has been so recurrent and insistent in its demands as that impelling him to similar locations. Whether explained in terms of a herd instinct, safety in numbers, or the economic and cultural stimuli of life in closely-integrated complex communities the drive to concentrate has constantly intrigued the social scientist whenever he has become space conscious, and is implicit in a great deal of geographical thinking. In the analysis of population distribution and migration, and in the study of urban development and morphology, it has enlivened much which would otherwise be purely empirical description. It is a basic concept in the delineation of social and cultural regions and in discussions of the areal differentiation of the earth's surface by economic endeavour. Indeed, in both process and structure situations it is significant to almost every aspect of man's spatial behaviour.

It is in the study of industrial location, however, that analysis of the mode of action and character of this force has reached its highest expression. Among the many stimulating hypotheses proposed by Alfred Weber [1] in his classic theory of the location of industry, for example, is the formulation of what he called 'the laws of agglomeration', covering those situations in which industry moves to concentration points to take advantage of the economies in production made possible by association. As in so much of his work such concentration, and the laws governing it, are considered as functions of transport and are accommodated within the locational framework established by transport and labour orientation. To him, too, we owe recognition of the fact that in most instances the forces of dispersion or deglomeration are end products of agglomeration, in the sense of counterforce to force, brought into being when the costing advantages of concentration are counteracted by the disadvantages of size and complexity expressed in land, transport, and labour values. For Weber it was important to know not only when but where this process was likely to occur, and, of course, from a geographical point of view it is this penchant of his to ask the right sort of questions that makes his work so stimulating. Many of his conclusions, however, have been questioned by later workers [2] who have elaborated the analytical techniques which Von Thünen [3] and he pioneered. Hotelling,[4] for example, has shown that in a situation or economic model in which two business competitors rival each other in a finite zone of inelastic demand the process of competition itself will

lead to their drawing closer together without placing undue emphasis on the factor of freight minimisation as suggested by Weber. More recently Lösch [5] has criticised Weber's approach on the grounds that it placed too much emphasis on production costs rather than on net profits and failed to take into account the internal complexity of market or demand regions. Rather than attempt to solve the locational problem of an individual firm Lösch investigates those regional structures which condition and motivate industrial location, and in so doing differentiates various types of agglomeration. His regions are defined not by self-sufficiency, factor mobility, or homogeneity, but by the complicated regional structure itself—the *Gestalt*—simultaneously and mutually determining its integral parts, while his theory of agglomeration is sufficiently general to embrace town growth and morphology as well as industrial sites. Lösch's theory thus supplements that of Weber, providing the general equilibrium to Weber's partial equilibrium and attempting to show with Weber " the mighty elements of spatial discipline . . . preserving geographical and cultural roots in spite of freedom ".[6]

The relevance of such ideas becomes apparent particularly in relation to the locational problems of economically under-developed territories, where industrialisation and urbanisation have not attained the complexity characteristic of modern Western Industrial societies, and the following comparative study of the locational pattern of two of India's most important industries seeks to determine to what extent they exhibit similar concentration and dispersal phenomena.

At the close of World War II, in spite of considerable changes in the industrial structure of India, the position of cotton and jute manufacturing industries remained unchallenged in the industrial hierarchy.[7] In productive capital employed, in the number of workers engaged, in the extra-factory value of products, and in terms of value added by manufacture they are outstanding. Cotton textiles employ almost 36 per cent of the national working and fixed industrial capital, and jute 13 per cent, in comparison to iron and steel (9 per cent), sugar (8 per cent) and general engineering (6 per cent), their nearest industrial rivals, while of the total national industrial labour force cotton with 13 per cent and jute with 22 per cent are undoubtedly the largest employers. The spatial application of these considerable forces of labour and capital, however, is very uneven. In cotton, Bombay Province is king with the greatest concentrations of looms and spindles in the cities of Bombay and Ahmedabad (see Figs. 1 and 2).[8] In jute, the majority of the 10·2 million spindles and 197,000 looms operative are located on industrial Hooghlyside. Thus in any analysis of the two industries the evolution of two great industrial port cities, Bombay and Calcutta, and their economic relationships with their respective hinterlands must figure prominently. The first cotton mill in Bombay was constructed at Tardeo in 1854 and in the following year the first jute mill was established at Rishra, thirteen miles north of Calcutta on the right bank of the Hooghly. Hence both factory industries have experienced a century of association with a major port, during a period in which India has attempted to regain something of her ancient industrial

status by participating in the world-wide diffusion of industrial techniques emanating from Western Europe.[9] Here we are not concerned with the mechanics of such diffusion except to note that it has usually proceeded initially by the industrialisation of ports of primary producing regions.

Cotton and jute fibres do not lose a great deal of weight in manufacture and consequently industries based on them are not strictly

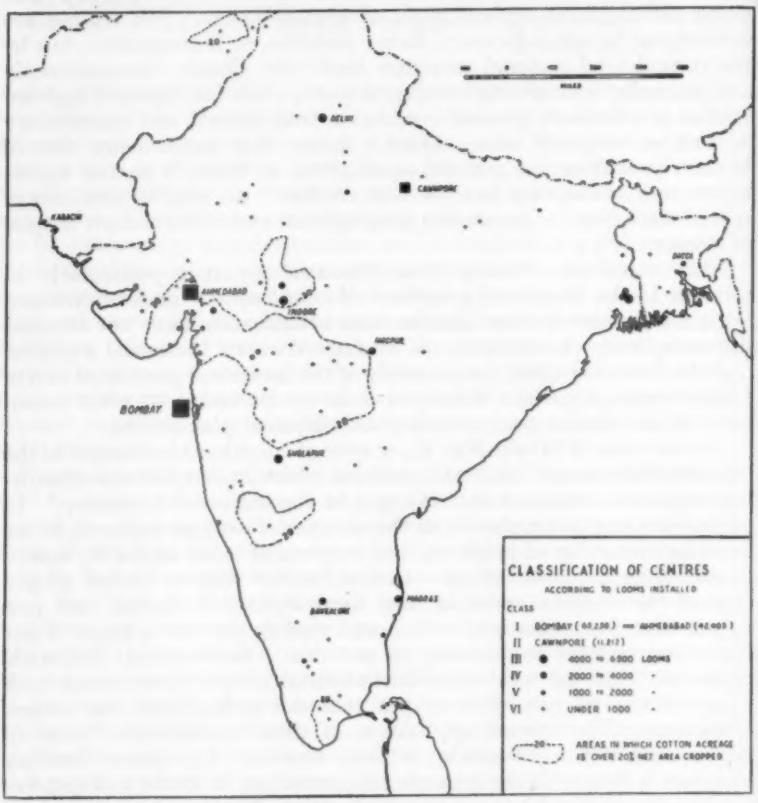

Fig. 1. Distribution of cotton weaving centres in India and Pakistan, 1949.

bound to the sources of raw materials. Nevertheless transport orientation has been an important factor in concentrating industry at the main assembly points of the raw material. In the early nineteenth century both commodities were exported from India in considerable quantities, particularly to British industrial regions. Bombay, in spite of the difficulties of transport from the interior due to poor roads across the Western Ghats and the forest barrier of the Konkan,[10] emerged as the main cotton exporting port of pre-railway India and the ports of

Kathiawar and Cambay, although more conveniently located in relation to the cotton growing districts of Central India, did not develop as serious rivals. Indeed the majority functioned as sub-ports shipping raw cotton to Bombay where the presence of foreign vessels was ensured by superior facilities. In Bengal a similar process may be observed in the collection of raw jute which, though increasingly grown in the better-watered districts of the eastern delta, was

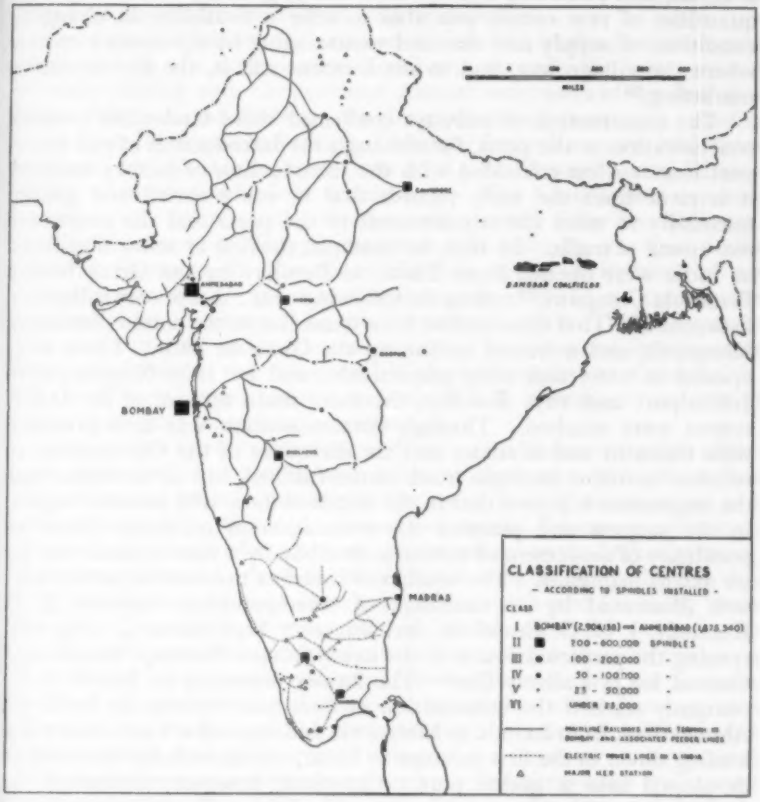

Fig. 2. Distribution of cotton spinning centres in India and Pakistan, 1949.

moved to the Hooghly for overseas shipment.[11] In other words the factors which at this period were producing the domination of a few major ports in overseas trade at the same time led to the concentration of cotton and jute marketing at two main centres. The emphasis was thereby shifted from ancient interior marketing localities to the seaboard, in sympathy with many other features of Indian life during the period of European rule.

Thus when factory industry was introduced into India from Britain

the marketing and commercial facilities already established at the great ports proved to be of immense attraction. This is particularly true of cotton where a transport location, allowing the assembly of various grades of cotton, marketed at different seasons, confers many advantages not possessed by a more circumscribed locality. Bombay, able to draw on the *Dholleras* and *Broaches* of Gujerat, the *Umras* of Khandesh, the medium stapled *Kumptas* of the south and long stapled cottons from overseas, and possessing facilities for storing, grading, and selling large quantities of raw cotton was able to offer a flexibility in changing conditions of supply and demand unattainable by up-country centres where the village was, and to some extent still is, the key to cotton marketing.[12]

The construction of railways confirmed these tendencies towards concentration at the ports, for although the introduction of rail transport more or less coincided with the introduction of factory industry it is clear from the early records that it was planned and geared essentially to meet the requirements of the ports and the coastward movement of traffic. In 1853 for example, the first 21 miles of railroad in India were opened from Thana to Bombay by the Great Indian Peninsula Company,[13] and in the following year reports were submitted in favour of a Thal Ghat incline for a trunk line to the cotton districts of Khandesh, and a second incline up the Ghats at Bhor. These were opened in 1865 and 1863 respectively, and by 1867 Nagpur, 1870 Jubbulpore and 1871 Raichur, the three main termini of the G.I.P. system were reached. Through communication was thus provided with Calcutta and Madras, and the directives of the Government in relation to major strategic trunk routes fulfilled, but at the same time the impression is gained that in the minds of those who invested capital in the projects and planned the orientation of particular lines the possibility of movement of cotton to Bombay by a new method was by no means negligible. The conflict of interests involved is particularly well illustrated by an exchange of correspondence between J. P. Kennedy, J. H. G. Crawford, and Governor Elphinstone in 1854 concerning the projected routes of the newly formed Bombay, Baroda and Central India Railway Co.[14] The former reporting on behalf of the company advised the construction of lines from Baroda to Delhi via Ahmedabad, from Baroda to Malwa via Indore, and a Tapti valley line leading down in the first instance to Surat, which he believed could be developed into a major port. Crawford, however, reminded the company that Bombay was the originator of the project and that capital had been subscribed with the " distinct and legitimate object of opening direct communication between Bombay and the cotton districts of Khandesh and Berar. It was not sought or desired to bring the produce of these districts down by a circuitous [*sic*] route to the port of Surat." Elphinstone on the other hand asked the pertinent question of " will the saving in the cost of transport by a shorter and more level line to Surat counter-balance the advantages which Bombay offers as a port of shipment ? " An answer was given in part by the fact that the B.B. and C.I.R. granted priority to the Bombay-Ahmedabad line, completed in 1864, and in part by a report in the *Times of India*, 22nd August, 1862,

that the construction of a steamer pier commenced at Surat two years earlier had been stopped. Surat was to continue its decline from ancient fame (when it had been the headquarters of the East India Company), and refrain from offering rivalry to the southern port to which it had given birth in the latter part of the seventeenth century. Meanwhile the B.B. and C.I. and G.I.P. railways with their main termini in Bombay Island successfully consolidated a catchment area for Bombay which has persisted up to modern times in a land of great distances and poorly equipped road transport.

In a similar fashion the position of Calcutta in the jute trade was confirmed by the construction of railways through the jute growing districts, linking with the extensive natural waterways of the Brahmaputra, Meghna and Padma. To the main broad gauge line running south from Jalpaiguri to Sealdah (Calcutta) feeder lines were built from Sirajganj and Goalundo, river ports on the Brahmaputra, and Khulna on the northern flank of the Sundarbans. The Khulna area was also served by the main canal route from the eastern delta into Calcutta. The first railway in Bengal, however, was built by the East India Railway Company in 1855 from Howrah on the right bank of the Hooghly opposite Calcutta to the Raniganj coalfield, to replace the slow and difficult transport on the Damodar River.[15] This line greatly stimulated mining and made coal available for industrial development along the banks of the Hooghly. With the completion of the E.I.R. system of the Gangetic plains and the B.N.R. system of east-central India Calcutta's hinterland was ensured.

The initial advantages conferred on a port location by the alignment of the railway network were substantially increased by the operation of freight rates favourable to the movement of materials to and from tidewater.[16] Although on many occasions the case against such practices, which are after all by no means unique to the Indian systems, has been overstated, the fact remains that they undoubtedly did discriminate against internal movement of materials and for many years checked the possible development of inland industrial centres. At first the various railway companies were left to devise their own rates on the basis of what certain classes of commodities could bear in competition with other means of transport, but in view of the growing complexity of the traffic and the monopolistic character of rail transport Governmental control over rate fixing in the interests of the general public soon became a customary practice. Principles were enunciated in March, 1883 (Resolution No. 162, Railway Traffic) and again in the preamble to a resolution of the Government of India dated the 12th of December 1887; uniformity in the classification of goods was first achieved in 1910; various bodies such as the Indian Industrial Commission of 1916-18 and the Ackworth Committee[17] of 1921 considered in detail the influence of railway rates on the economic development of the country and eventually Railway Rate Advisory Committees and Tribunals were set up, but throughout the individual companies had a reasonable degree of freedom in fixing rates within the maximum and minimum figures established by the Government, and the principle of 'telescopic' rates, decreasing with distance, was

generally accepted as legitimate. As such telescopic rates, however, applied only to the particular company's lines, movement between systems was discouraged, and while the freedom to compete did provide cheaper services, particularly in those zones such as Upper India where port and railway catchment areas overlapped, it also resulted in a multiplicity of special rates including a large number of reduced rates to and from ports. This was usually justified on the grounds that India had a considerable exportable surplus of raw materials which had to be marketed overseas as cheaply as possible ; and similarly, until the country became self-sufficient in the manufacture of consumer goods, imported commodities had to be transported up-country as cheaply as possible, even if they did compete with home produced articles in the interior. The port industries thus derived the benefits of traffic in both directions—cheap raw materials and cheap transport of finished goods to the interior consumer markets.

These advantages arise from the regional forces implicit in the mutual relationships of port and hinterland. One can add to them, the general facilities of a port as a station on world-wide seaways, enabled to import such items as textile machinery and chemicals, and export finished products with a minimum of relatively costly land transport ; the general circumstance that large ports established by European sea-powers in colonial areas have in many instances achieved the status of administrative capital cities, with large populations providing both an available labour supply and concentrated consumer markets close at hand ; and the general economies achieved by the congregation of similar or associated enterprises. Furthermore in these cases there were the particular advantages of having local labour forces with long traditions of textile working at a domestic level, and sources of mechanical power reasonably accessible in the Damodar coalfields [18] or, at Bombay, by sea transport and later H.E.P. stations in the Western Ghats. From such considerations it is possible to gain some measure of the forces of concentration which have made Bombay and Calcutta so pre-eminent in the cotton and jute industries respectively.

As was indicated earlier, however, such concentration has a tendency to develop counter-forces of dispersion. Although the latter may ultimately be expressed in economic terms it is apparent to a geographer that often both the time and place of the initiation of such forces is conditioned by the physical nature of the site of the original concentration. This is particularly true of port sites where such a variety of demands, often conflicting, are made on a limited terrain, restricted by its very nature to expansion only in certain directions. Bombay and Calcutta illustrate the varying degrees of these problems admirably.

In Bombay most of the cotton mills are located in the central industrial zone of the island shown in Figure 3. This area was originally occupied by tidal swamps overlooked by an encircling group of small islands which constituted the early Bombay. Reclaimed during the first half of the eighteenth century by damming the tidal breaches between the islands, it was first utilised for the cultivation of rice, but when the site of the original settlement of Bombay (Zone 1) became too congested, provided cheap land for industrial expansion. As the

cotton mills spread northwards through this zone, however, the movement of raw cotton within the island became more and more com-

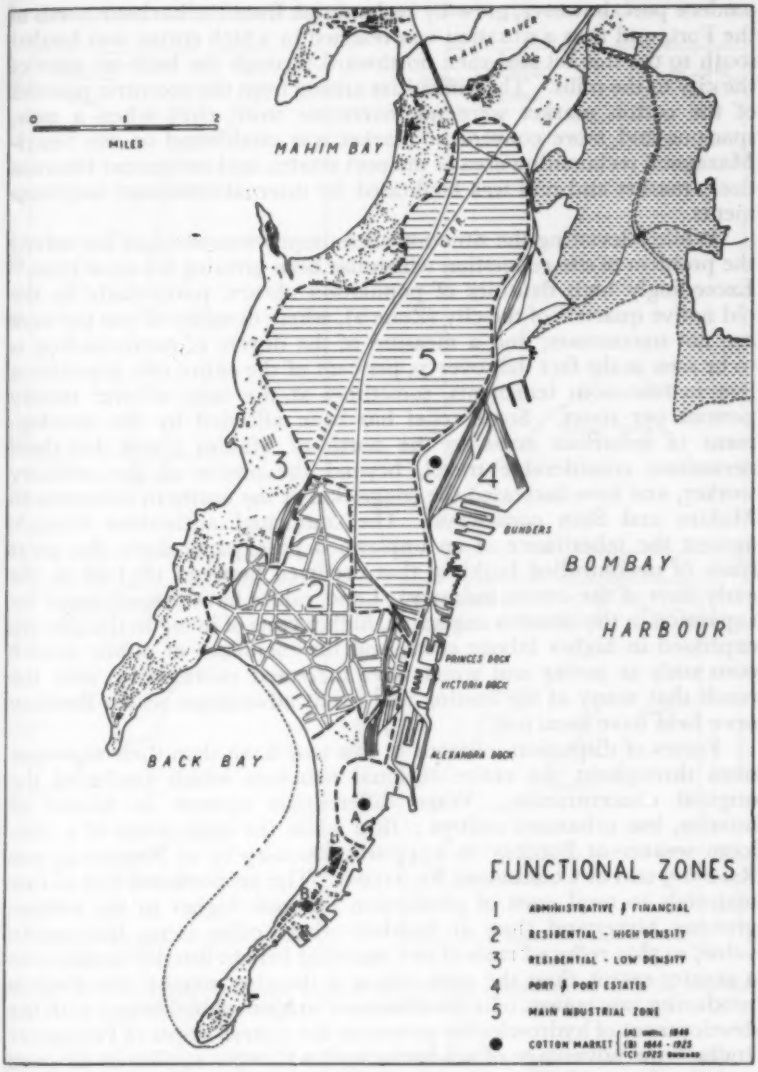

Fig. 3. Bombay : Main Functional Zones of the city. Zone 1 (the fort) was the site of the original East India Co. settlement on Bombay Island.

plicated. The earliest position of the Bombay cotton market or green was on the site of what is now known as Elphinstone Circle within the

Fort, but in 1844, at a time when the export of raw cotton was dominant and most of it arrived by country boat from Gujerat, the market was moved southward to Colaba causeway to relieve congestion. The modern port, however, grew by reclamation from the harbour north of the Fort, and thus a situation was reached in which cotton was hauled south to the market and then northward through the built-up zone of the city to the mills. The difficulties arising from the eccentric position of the cotton market were not overcome until 1925 when a new, spacious and more convenient market was established on the Sewri-Mazagaon reclamation area of the port estates, and movement between dock, market and mill was facilitated by internal transport improvements.

While alleviating the situation these improvements have not solved the problem of site congestion which has been growing for some time.[19] Exceedingly high densities of population obtain, particularly in the old native quarters of the city (Zone 2), where densities of 700 per acre are not uncommon, and a measure of the degree of overcrowding is to be seen in the fact that over 75 per cent of the entire city population live in one-room tenements, sometimes at the ratio of over twenty persons per room. Some relief has been afforded by the development of suburban areas to the north of Mahim Creek but these necessitate considerable travel, beyond the means of the ordinary worker, and have increased the congestion at the northern entrances to Mahim and Sion causeways. The municipal authorities struggle against the inheritance of an unplanned past, particularly the great spate of uncontrolled building that occurred between 1851-88 in the early days of the cotton industry. Land values have soared, room for expansion in the island is negligible, higher costs of living in the city are expressed in higher labour costs, and the incidence of public service costs such as power and water have increased enormously, with the result that many of the costing and profit advantages which Bombay once held have been lost.

Forces of dispersion initiated in this way have then their repercussions throughout the entire regional structure which produced the original concentration. Wage differentials operate in favour of interior, less urbanised centres ; thus while the daily wage of a two-loom weaver at Bombay in 1944 was Rs. 2-13-11 at Nagpur it was Rs. 2-6-9 and at Coimbatore Rs. 1-10-0. The proportional cost of raw materials to total costs of production becomes higher in the cotton-growing hinterland than at Bombay where other items increase in value, so that reduced costs of raw material benefit interior localities to a greater extent than the port city and thereby 'weight' the districts producing raw cotton. In the absence of major coalfields and with the development of hydro-electric power on the eastern slopes of Peninsular India [20] the advantage of sea-borne coal no longer applies in all cases and the forces of dispersion are allowed wider range. Furthermore with the closure of overseas markets for cotton goods, particularly in the East, Bombay producers were obliged to turn inwards towards the home market for yarn and piece goods.[21] So long as favourable freight rates existed this they could do, with the only real competition

coming from foreign, especially Japanese, producers, but as the agitation against unequal rates strengthened, the market areas of interior centres extended and the protection of physical distance became more real. It will be observed that in the nationalised and re-

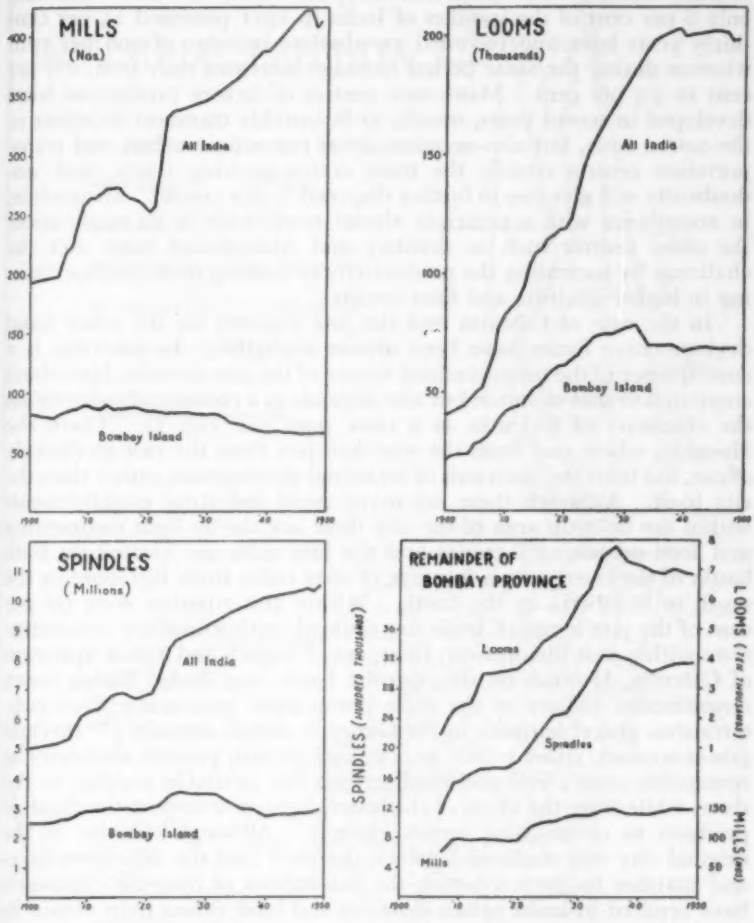

Fig. 4. The relative development of cotton manufacturing installations in India, Bombay Island and Bombay Province (excl. Bombay Is.) 1900-50.

grouped railway systems of independent India, a new rates structure has been introduced, applying telescopic rates over the entire railway network and establishing unequivocally that internal traffic should be treated on a par with export and import traffic.

The speed and size of the dispersal movements in cotton are shown in the graphs of Figure 4, and the distributional stage reached by 1949

in Figures 1 and 2. It will be noted that the dispersal of spindles has occurred to a greater extent than looms, partly as a result of the encouragement given by the *swadeshi* movement and State governments to the large numbers of handloom weavers who still operate in the country districts. Madras Presidency, for example, which contained only 6 per cent of the spindles of India in 1911 possessed 15 per cent thirty years later and recorded an absolute increase of 300 per cent whereas during the same period loomage increased only from 2·6 per cent to 3·3 per cent. Many new centres of factory production have developed in recent years, usually at favourable transport locations in the cotton zone, but also occasionally at convenient urban and transportation centres outside the main cotton-growing tracts, and undoubtedly will give rise to further dispersal in due course. Meanwhile, in accordance with a principle almost world-wide in its application, the older centres such as Bombay and Ahmedabad have met the challenge by increasing the productivity of existing units and specialising in higher qualities and finer counts.

In the case of Calcutta and the jute industry on the other hand deglomerative forces have been almost negligible, In part this is a consequence of the more confined nature of the jute-growing hinterland compared to that of cotton but also depends to a considerable degree on the character of Calcutta as a river port (see Fig. 5). There the Hooghly, where coal from the west and jute from the east go cheaply afloat, has been the main axis of industrial development rather than the city itself. Although there are many small industrial establishments within the built-up area of the city these are chiefly light engineering and food-processing factories and the jute mills are located on both banks of the river, over a frontage of sixty miles from Birlapore in the south to Bansberia in the north. Within this riparian zone 96 per cent of the jute looms of India are situated, with subsidiary concentrations within it at Bhadreswar, Bhatpara, Titagarh and Salkia upstream of Calcutta, Howrah on the opposite bank, and Budge Budge lower downstream. Many of the mills pump their own water from subterranean gravel horizons in the Gangetic deltaic deposits ; [22] thermal power-stations, either public or company owned, provide electricity at reasonable costs ; rail and road services are available parallel to the river, while from the ghats of the latter, lighters transport the finished products to ocean-going vessels cheaply. Although the site of the original city was confined between the river and the salt-water lakes and marshes to the south-east, the possibilities of riverside expansion have resulted in lower urban densities and land values than obtain in Bombay. One expression of this has been the ability to develop large, single-storied units, which have many technical advantages over multi-storied mills on cramped sites such as exist in Dundee, for example, and it is interesting to note that the average-sized unit on Hooghlyside (600 looms and 13,500 spindles) is almost three times as large as that found in the Scottish centre of the industry. Labour is plentiful, though not so skilled as it was, since the townward migration of old handloom weavers has been swamped by the vast tides of landless agricultural labourers which have swept into Hooghlyside during the

last fifteen years. Of the present labour force of over 300,000 employed in the jute industry a minority originates in Bengal, the vast majority

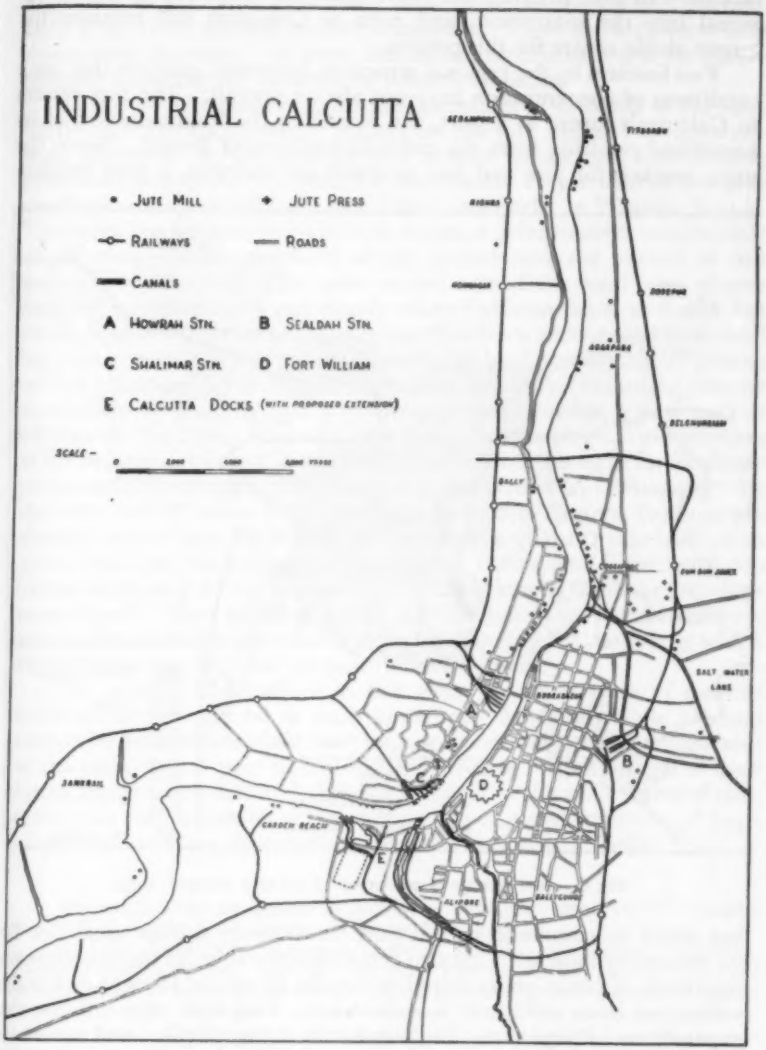

Fig. 5. Industrial Calcutta : Jute mills and presses in relation to transport facilities.

being floating labour from Bihar, Orissa, the United Province, and Chota Nagpur ; and these immigrants have usually accentuated the slum halos round the industrial units of the conurbation. Real labour

costs have indeed risen sharply in recent years but have not been sufficient to outweigh the other advantages offered by Hooghlyside. In fact only in jute pressing has there been any tendency towards dispersal into the hinterland, and even so Cossipore still remains the largest single centre for this process.

Two features in the regional structure, however, indicate that such conditions of concentration may not always prevail. The first relates to Calcutta's future as a port, the second to the fragmentation of its hinterland resulting from the political partition of Bengal. Since the main markets for jute and jute products are overseas, a port location

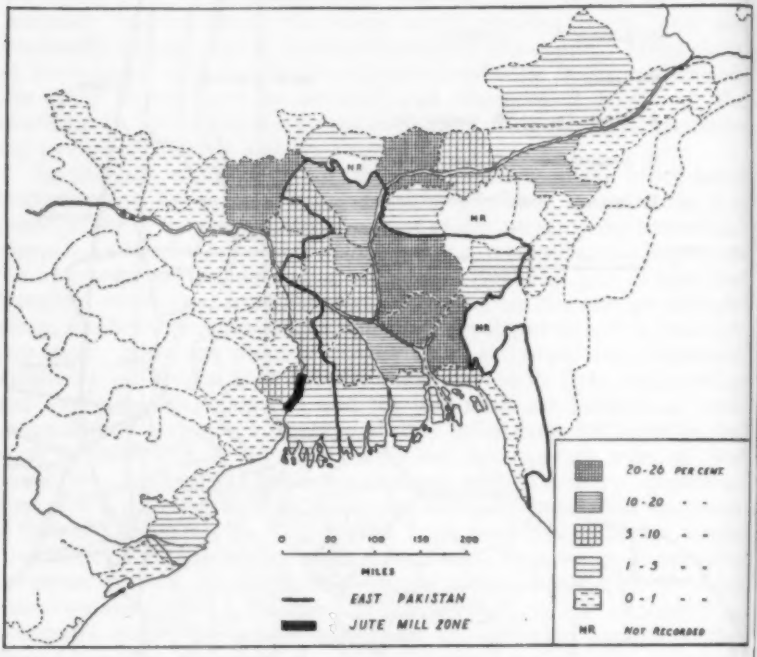

Fig. 6. Jute acreage as percentage of net area cropped, 1939.

has much to commend it, but port locations in deltaic areas are by no means permanent. Calcutta represents one stage in the downstream migration of ocean-going shipping termini along the Hooghly—a stage which has been artificially sustained for a long time now only by the expenditure of large sums of money on dredging, pilotage and maintenance works on one of the most capricious river channels in the world.[2] Draft restrictions have had to be imposed since only rarely can vessels drawing thirty feet negotiate the river ; not infrequently ships have to lighten their load at Vizagapatam before proceeding to Calcutta ; and it is now proposed to construct a ship canal from the Kidderpore Docks to Diamond Harbour forty-two miles downstream. While the cheap-

ness of water transport in the case of a river port allows a considerable latitude between industrial sites and shipping termini, the seaward migration of the latter eventually must influence the former, particularly if the older centres become congested. These are long-term considerations, however ; of more immediate significance are the consequences following the creation of Eastern Pakistan.

This is not the context to discuss the merits or demerits of the 1947 partition,[24] but its economic impact on the jute industry is apparent from Figure 6. By the drawing of a frontier which paid little heed to economic, transport, or regional realities some 80 per cent of raw jute production was cut off from its markets and outlet in Western Bengal. The result has been, as usual in such events, a drive towards uneconomic duplication. India, deprived of her control over the sources of raw material which account for over 70 per cent of the total costs of production, and having to pay dearly when Pakistan failed to follow her example in devaluation of the currency, has been encouraged to expand her jute acreage often at the expense of vital food production. Pakistan on the other hand has sought alternative means for exporting jute by developing Chittagong into a major port and creating a new port at Chalna on the Pusur River.[25] The latter, which came into operation at the beginning of 1951, is to serve the jute districts west of the Brahmaputra and relieve some of the heavy burden placed on Chittagong. At the same time schemes for the industrialisation of Eastern Pakistan are already under way, including the completion of three jute mills with 3,000 looms at Narayanganj, river port of Dacca, and a further 3,000 looms sanctioned by the Government to complete its Six-Year Development Plan.[26] Thus political factors, also at work in the cotton industry, are tending to act as dispersal agents, challenging the monopoly which Hooghlyside has held for the past hundred years.

The general applications of this study to other areas of nascent industrialisation will be at once apparent. Many erstwhile colonial territories have made their first steps towards industrial development at the seaboard, at port sites of foreign choosing. The pattern of their future growth, it is contended, will be subject to the same forces of concentration and dispersal, acting within the regional structure of port-hinterland, as have operated on the sub-continent of India.

[1] WEBER, A., *Ueber den Standort der Industrien.* Tübingen, 1909. (English translation by C. J. Friedrich, University of Chicago Press, 1929.)

[2] See *inter alia* PREDOHL, ANDREAS, Theory of Location and General Economics. *Journal of Political Economy*, 1928, 36 : 371-390 ; HOOVER, E. M., *Location Theory and the Shoe and Leather Industries*, Cambridge, Mass., 1937 and *Location of Economic Activity*, New York, 1948 ; SARGENT F. P. and WENSLEY, A. J., *The Localization of Industry*, London, 1945. The literature on industrial location, which is immense, is conveniently summarised by KRZYZANOWSKI, W. Review of the literature of the Location of Industries, *Journal of Political Economy*, 1927, 35 : 278-291, and MCDONALD, D. M., *A select bibliography on the Location of Industry*, McGill University, 1937 ; while a good introduction to locational problems in India may be obtained from Sharma, Tulsi Ram, *The Location of Industries in India*, Bombay, 1948 ; MEHTA, M. M., *Structure of the Cotton Mill Industry of India*, Allahabad, 1949 ; BALKUSHNA, R., Limitations of the Deductive Theories of Industrial Location. *Indian Journal of Economics*, 1946, pp. 117 *et seq.* ; LOKANATHAN, P. S., Urbanization and Industrial

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[6] LÖSCH, *op cit.*,, p. 508.

[7] THOMAS, P. J., *India's Basic Industries*, Bombay, 1948.

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[14] *Selections from Record of the Bombay Government*, IX (New Series), 1855.

[15] HUDDLESTON, G., *History of the East India Railway*, Calcutta, 2 vols., 1906, 1939.

[16] For details see TIWARI, R. D., *Railway Rates in Relation to Trade and Industry in India*, Bombay, 1937 ; Government of India Ministry of Railways, *Indian Railways One Hundred Years, 1853-1953*, New Delhi, 1953. Chap. XXI.

[17] *Report of the Committee appointed by the Secretary of State for India to inquire into the administration and working of Indian Railways* (Sir William M. Acworth Report), 1920-21. H.M.S.O., 1921. Chap. V.

[18] KIRK, W., The Damodar Valley—Valles Opima. *Geographical Review*, 1950, 40 : 415-443.

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[26] See *The Colombo Plan*. Report by the Commonwealth Consultative Committee, H.M.S.O., 1950, and successive progress reports ; also Board of Trade, *Report of the U.K. Industrial Mission to Pakistan, 1950*, H.M.S.O., 1950.

GEOMORPHOLOGY: SOUTH-EASTERN ENGLAND AND NORTHERN FRANCE: A REVIEW

J. B. Sissons

"Truth in geomorphology, indeed, is seldom more than increasing probability." These words of Baulig, quoted by Pinchemel on the cover page of his book,[1] are eminently applicable to the history of geomorphological research on south-eastern England and northern France. For more than a century the volume of geological and geomorphological literature on these two areas has been growing at an ever-increasing rate, different authors successively putting forth strong arguments in support of their own interpretations. Yet the older views have each in turn been modified or even abandoned. One is apt to forget that the most recent interpretations—often those having the authority of eminent contemporary geomorphologists—may themselves, despite their often apparently convincing arguments and weighty evidence, suffer in like manner. Thus the publication of Pinchemel's book on part of the scarplands of south-eastern England and northern France should provide enlightening reading for those British geomorphologists who appear to regard the most recent British interpretations of the evolution of the landforms of south-eastern England as approaching finality. It is perhaps significant that no major criticisms of Wooldridge and Linton's work on this area should have been published by British geomorphologists and that the first should emanate from the other side of the Channel.

There can be no doubt, however, concerning the very important contribution to geomorphology made by Wooldridge and Linton's *Structure, Surface and Drainage in South-East England.* It is unnecessary to extol the merits of this book for it has become indispensable to British students of denudation chronology. The second edition [2] incorporates numerous minor modifications of the original text and, in addition, a valuable summary and critical discussion of the very detailed researches carried out in certain parts of south-eastern England since the appearance of the first edition in 1939. Unfortunately the generally high quality of the illustrations is marred by the minor discrepancies and deficiencies that were present in the first edition. For example, no vertical or horizontal scale is given in Figure 12; a part of the Dorsetshire Stour is shown as a consequent stream in Figure 18 but is not marked as a discordant stream in Figure 19 (it is perhaps significant that this important stream is not once mentioned in the text). The discrepancies in Figures 11, 18 and 19 concerning the number of islands rising above the 'Pliocene sea' near Basingstoke appear to be related to the lack of precise evidence concerning the 'Pliocene bench,' for no evidence is given in the text that the height of this feature has been determined in the field. The retention of the term 'Pliocene bench' to describe the erosion surface (or surfaces?) situated between

about 550 and 700 feet is unfortunate, for other benches probably of Pliocene age have been recognised both in south-eastern England and in other parts of Britain.

Turning to Pinchemel's book we find that it derives part of its inspiration from the work of Wooldridge and Linton. Pinchemel acknowledges the help he has received from the former, and his text indicates his extensive use of the publications of both authors. The introduction is followed by four chapters concerned with the evolution of south-eastern England and northern France to the end of the Eocene ; a discussion of the later Tertiary evolution of these regions and of the Channel ; several chapters devoted to a detailed and somewhat tedious description of the geological structure and its influence upon the landforms ; four chapters, wherein lies the author's principal contribution to geomorphology, in which the problems of drainage evolution are discussed in detail ; a series of notes on various aspects of the Quaternary landforms ; and, finally, a list of 600 references.

One feels that Pinchemel's book could have been considerably reduced in length without detracting from its value. On the other hand the evidence is clearly stated and the conclusions drawn from it in general fully explained. Unfortunately there is frequent evidence of haste in the preparation of the book : English place-names are in some instances mis-spelt, the conversions of feet to metres sometimes incorrect, and the references not always accurate. Pinchemel emphasises throughout that the landforms of south-eastern England and northern France have passed through the same stages of evolution, and the arrangement of his material reflects this emphasis. One regards with suspicion, however, his recognition of erosion surfaces at regular height intervals of 20 metres between altitudes of 60 and 200 metres in northern France : even more surprising is his claim that the heights of these surfaces correlate with those of the surfaces recognised in south-eastern England (while such correlations may be valid [3] Pinchemel's evidence is insufficient to substantiate them).

Although the greater part of Pinchemel's book is concerned with northern France, the views of Briquet especially being subjected to severe criticism, British readers will probably be primarily interested in his interpretation of the evolution of south-eastern England, especially since this differs significantly from that of Wooldridge and Linton regarding the earlier stages.

The latter consider the exhumed sub-Eocene surface to be mainly confined to the lower parts of the Chalk dip-slopes and hence of relatively limited extent, and suggest that in the central Weald the altitude of this surface " may have exceeded 3,000 feet ". Pinchemel, however, assigns far less importance to post-Eocene denudation : basing his conclusions mainly on a study of the clay-with-flints and of isolated Eocene outliers, he considers the sub-Eocene surface to have coincided with or passed but little above many of the present summits. It is not always clear, however, how he reconciles this interpretation with the consequences of later earth-movements.

The two British authors regard those parts of south-eastern England

lying above about 700 feet as remnants of a Mio-Pliocene peneplain that was gently downwarped to permit the entry of the ' Pliocene sea ' into the London and Hampshire basins. They maintain that the parts of this peneplain lying above about 700 feet are essentially unwarped and were not submerged by this sea, the drainage of this unsubmerged area now being in a second major erosion cycle. They also regard the ' Pliocene bench ' as essentially unwarped (except in East Anglia and perhaps in eastern Kent), and maintain that the emergence that followed its formation resulted in the development of a new drainage system, which contrasts with the well-adjusted drainage of the unsubmerged areas.

Pinchemel, however, finds it difficult to believe that a large part of south-eastern England should have remained essentially stable since mid-Tertiary times while extensive subsidence occurred in the adjacent North Sea basin. He states that it is generally accepted by French geomorphologists that the Miocene surface in the Paris Basin was deformed by movements at the end of the Miocene that one would expect to have been propagated into south-eastern England. He points out that along a large part of the North Downs the position of the ' Pliocene coastline ' cannot be determined, while in Wessex the remains of the ' Pliocene bench ' are admitted by Wooldridge and Linton to be of a fragmentary character. Hence their claim that the ' Pliocene bench ' is essentially horizontal throughout this area is difficult to substantiate. The fact that they refer to a bench at one point on the North Downs situated between 700 and 750 feet which, they suggest, may have been formed by marine plantation, is difficult to reconcile with the claim that the submergence elsewhere did not exceed 700 feet. Pinchemel also refers to the fact that Wooldridge and Linton's conclusions are inconsistent with the recognition in other parts of Britain of apparently unwarped erosion surfaces up to 1,000 feet above sea-level, for which Pliocene ages have been suggested. He considers unsatisfactory the evidence for a two-cycle drainage evolution in the areas unsubmerged by the ' Pliocene sea ' and states that Wooldridge and Linton's discussion is based on ' an interpretation of the evolution of the drainage system that seems mostly subjective ' (p. 146).

Pinchemel's own interpretation, as he points out, is similar in certain respects to that put forward long ago by Ramsay, Foster, Topley and Bury, but whereas these writers considered the consequent drainage to have developed on a deformed marine platform, he concludes that it originated on a fluvio-marine plain. He believes that such a plain was extensively developed in south-eastern England and that its warping (for example, along the Pewsey-Kingsclere axis and along the central Wealden axis) in middle Pliocene times resulted in the development of the present consequent drainage system, subsequent intermittent emergence resulting in the production of erosion surfaces, the incision of the consequent streams, and the developmemt of structurally adjusted streams.

These brief comparisons reveal some of the important differences between the conclusions reached by Wooldridge and Linton on the one hand and by Pinchemel on the other. No British geomorphologist

should neglect to study and compare carefully the evidence and deductions contained in their respective publications.

[1] PINCHEMEL, P. *Les Plaines de Craie du Nord-Ouest du Bassin Parisien et du Sud-Est du Bassin de Londres et leurs Bordures :* Étude de Géomorphologie. 25×17 cms. Pp. 502. 49 figs. 34 photographs. 6 folding sheets. Paris : Librairie Armand Colin. 1954.

[2] WOOLDRIDGE, S. W. and D. L. LINTON. *Structure, Surface and Drainage in South-East England.* 9¼×7. Pp. viii+176. 32 figs. London : George Philip and Son Ltd. 1955.

[3] SPARKS, B. W. Erosion-Surfaces around Dieppe. *Proceedings of the Geologists Association.* 1953, 64 : 105-117.

REVIEWS OF BOOKS

EUROPE

The Making of the English Landscape. By W. G. HOSKINS. 8¼×7. Pp. 240. 82 plates+frontispiece. 17 maps and plans. London : Hodder and Stoughton Ltd, 1955. 25*s*.

Dr Hoskins is well known for his broadcast talks on what the geographer would probably call the development of the cultural landscape. To a smaller circle of economic historians and historical geographers he is also known for his researches dealing with the agrarian history of Devon and Leicestershire. *The Making of the Landscape* introduces a series of county volumes of which those on Cornwall, Lancashire, Gloucestershire and Leicestershire with Rutland have already been published or are in preparation. Two of these, incidentally, have been written by geographers.

The author writes about ' the historical evolution of the landscape as we know it ' and thus concerns himself with ' everything that has altered the natural landscape '. He takes the present landscape of England and tries to explain ' how it came to assume its present form, how the details came to be inserted and when '.

The result is not so much ' a new kind of history ', as the publishers tell us, but a popular work on developmental historical geography. Such an approach is by no means new, although there has possibly been a reluctance on the part of human geographers—unlike geomorphologists—to adopt an uninhibited genetic approach towards their landscape studies. Dr Hoskins is therefore constantly walking off with the geographer's clothes and also, as it were, refurbishing them for the public eye.

The treatment of such a wide topic is necessarily suggestive rather than exhaustive, with examples chosen mainly from the East Midlands and the South-West. A curious prejudice against industrial development and urban growth occasionally rears its head and will irritate the reader expecting a more dispassionate approach. All readers will deplore the badly reproduced photographs.

R. H. O.

The Highlands in Colour. Photographed by W. S. THOMSON : introduced by W. H. MURRAY. 10×7½. Pp. 64 (7 text+54 pages of photos). Edinburgh : Oliver and Boyd Ltd, 1954. 12*s* 6*d*.

Scotland. By G. S. Fraser and Edwin Smith. 12¼×9. Pp. 62+191 black and white and 3 colour plates. 1 map. London: Thames and Hudson Ltd, 1955. 42*s.*

The first book is an album of 63 magnificent colour plates, mostly 6 by 8 inches, of the exceedingly high standard which we have come to expect from Mr Thomson. The second volume is in black and white and contains 191 plates, mostly 8 by 11 inches. Scotland has been much photographed, some would say *ad nauseam*, but this latter volume contrives to combine high technical quality with a remarkable freshness of view and an unconventionality of choice which gives a remarkably complete visual picture of Scotland. The 35 pages of text are a most worthy summary survey of the country from many angles, not the least geography, and well qualify the book for its simple title. R. M.

Ulster Folklife. Issued by the Committee on Ulster Folklife and Traditions. 9¼×7¼. Pp. 56. 6 plates. Belfast, 1955.

This is a publication of the Committee on Ulster Folklife and Traditions which was set up some years ago to carry out for Ulster work similar to that done by the English Folklore Society, or the Irish Folklore Commission in Dublin. It contains an explanatory introduction and nine articles on widely different aspects of the subject, three of which are contributed by geographers. A general discussion on the study of folklore gives the layman some idea of the scope and value of the subject, and geographers will be interested in an account of the little-known Irish Ordnance Survey Memoirs which are detailed descriptions of the landscape made between 1830-40 by the surveyors of the time. Other articles include a discussion on the people of the forths (forts) and the Ulster farmhouse. Both these are interesting and well illustrated but could be of greater value still if accompanied by distribution maps.

It is difficult to tell whether this Journal is to be a medium for the publication of original research or a means of presenting, to a wider public, material that has already appeared elsewhere. The present number does both and this, perhaps, is wise for it will ensure a wider circulation than it might otherwise have.

Members of the Committee on Ulster Folklife and Traditions are to be congratulated for the initiative they have shown in issuing an attractively produced and readable publication that is sure to spread interest in their subject. It is hoped that the Committee will get generous support for their venture so that funds will be available to allow future issues to appear at regular intervals.

J. P. H.

Highlights of the Donegal Highlands. By H. P. Swan. 9×6. Pp. xv+186. 97 plates. 2 endpaper maps. Belfast: H. R. Carter Publications Ltd, 1955. 12*s* 6*d.*

This is a scrapbook of information on a variety of subjects including topography, archaeology, social life, history, legends, customs, with a certain amount of poetry. A good deal of interesting material is included and it should give pleasure to those who visit Co. Donegal. T. W. F.

AFRICA

Southern Africa. A Geographical Study. By John H. Wellington. Two volumes. 9½×6¾. Vol. I. Pp. 528. 97 photographs. 96 figures and maps. 4 maps in end pocket. 70*s.* : Vol. II. Pp. 283. 14 photographs. 25 figures and maps. 4 maps in end pocket. Cambridge: Cambridge University Press, 1955.

This new two-volume work on southern Africa by the Professor of Geography in the University of the Witwatersrand is an authoritative and valuable addition to the

post-war literature on African geography, and belongs to the class of text-book which places more weight on information than on facile, airy interpretation ; a great store of published material from many and varied sources has been gathered into these two volumes, and many geographers will appreciate them on this account.

The area treated is that part of the continent south of the Congo basin, including the basin of the Zambesi. This delimitation will not appeal to everyone ; many may feel that Angola, Northern Rhodesia and Nyasaland should be included more properly in a work covering the savanna and forest zones, and, indeed, Professor Wellington's own excellent maps seem to suggest that the northern limit of ' Southern Africa ' is further south than the line he has chosen. However, the selected boundary reflects the point of view from which the study has been approached, namely the structural and morphological : the first, physical, volume is almost twice as long as the economic and human volume, and many times better illustrated.

Volume I is a careful analysis of the physical character of the landscape, including a detailed description of some thirty sub-regions based on form and structure ; such detail, tedious reading perhaps, is welcome in that it brings home to the reader some of the significant variety that occurs within the apparently monotonous and featureless plains and plateaus of Africa. One would have appreciated a more general statement describing the morphology of the landscape as a whole ; an explanatory description in the style of W. M. Davis may not be justified at present, but surely some kind of *concise* chronology of the development of surface forms might have been attempted, even at the expense of something from the geological catalogue ; a morphological map would have been exceptionally helpful in place of the coloured relief map with contour interval of 2,000 feet, and somewhat misleadingly entitled " Altitudinal Zones ". Climate, particularly in the southern part of the area, is attractively treated, special attention being given to pressure systems and their associated weather types, and to variability. There is a welcome chapter on coastal morphology, and fully one-third of the first volume is devoted to hydrography, since, as the author points out, considerations of water supply are fundamental to the economic development of the territory, not only agriculturally but also for industry.

Used in conjunction with moderately large-scale maps, the first volume will greatly aid the study of the geography of southern Africa, and the amount of information crowded into it is quite remarkable. One is less sure of the value of the analytical technique as employed in Volume II—Economic and Human Geography. This volume is divided into three parts, entitled Land Utilisation, Mineral and Other Industries, and The People ; each part is subdivided, so that whole chapters are devoted to maize, wheat, fruit, sugar, animal husbandry, soil conservation, and land classification in Part 1, these last two chapters being particularly interesting. Part 2 is, *mutatis mutandis*, similar. The great disappointment of the book comes in the last part, which turns out to be little more than a quick summary of the history of the main racial groups, with a few population statistics incorporated ; there are no maps showing the spread of settlement, and there is little by way of ordinary historical geography or the development of the cultural landscape. No clear answers are given to many of the questions one might expect to be dealt with in a study of the ' human ' geography of South Africa ; there are only two diagrams illustrating this section of the book, one showing the routes between Holland and the East Indies, and the other vaguely locating the main native groups in southern Africa. In fact, the economic and human geography receives very summary treatment, as compared with the physical basis.

It is no valid criticism that this important work is based on topics rather than on the regional style of treatment but it is to be regretted that, in spite of its thoroughness, it does not create a particularly clear picture of southern Africa ; analysis rather than regional synthesis is the keynote, and the person who defined geography as mere additive description might tend to be confirmed in his opinion. While many shorter, more superficial, books may well give the average reader a clearer impression of this socially important territory, the present work will be of inestimable value as a standard work of reference for many years, particularly on the physical geography ; the pity is that the volume on man and his works in relation to the geographical environment, though valuable, does not maintain the high standard set in the first volume.

A. MacP.

ASIA

To the Third Pole. By G. O. DYHRENFURTH. Translated by Hugh Merrick. 10×7½. Pp. xxvi+233. 47 plates. London: T. Werner Laurie, 1955. 30*s.*

The author sets out to give a concise review of the various expeditions to the higher Himalayan peaks. The descriptions are of necessity brief but the conditions and expeditions to all the major peaks are tabulated. The book was written before the conquest of Kanchenjunga in 1955. With its diagrams and tabulatings it is a useful reference book.

A. H.

Kanchenjunga. By JOHN TUCKER. 9×6. Pp. 224. 35 plates and figs. London: Elek Books Ltd, 1955. 21*s.*

This is an account of a small exploratory party which went out to examine the South West approaches to Kanchenjunga, an approach which for some years had been out of favour. The party was so successful that it was able to work out a route which a larger party was able to exploit in 1955 and reach the summit. The party consisted of five members with mountaineering experience and a doctor. Three of the party had no previous Himalayan experience. The author was one of these members who had not previously been in the Himalayas and the account does have a freshness which some books on the Himalayas lack. The illustrations are excellent.

A. H.

AMERICA

Virginia at Mid-Century. By JEAN GOTTMANN. 9½×6½. Pp. vii+584. 64 maps and graphs. 197 photos. New York: Henry Holt and Co. Inc., 1955.

The happy coincidence of Jean Gottmann's presence at Princetown and the enthusiasm of the Old Dominion Foundation has reacted to produce a valuable contribution to the geography of part of the U.S.A., and a challenge to American geography. As the introduction suggests, the book might well become the pilot work of regional monographs for the other states. Certainly this regional analysis, done in the tradition of the French school of geography, is authoritative and scholarly, and yet written with such clarity and wit as to strengthen the belief that regional interpretation and description is indeed an art.

The first of the three parts of this work is entitled 'The Land and the People', and to the author the people are more important. One will not find an extensive treatment of the physical geography of Virginia, although it forms the basis for the regional framework upon which the details of the monograph are hung. Following the tracing of nearly three and a half centuries of history, the regional divisions are set down and defended.

Part Two, 'The Use of the Resources' displays American influence in that it surveys the development of Virginian forestry, agriculture, mining, and manufacturing, ending with the prospects and recommendations for the future. Necessarily the time factor is the thread through this part of the story. Changing values within the state and in relation to the rest of the Union are apparent throughout this survey but are especially important in Virginia's relative geographic location.

'Rejuvenation' is a key word the author uses and repeats in describing how 'The Old Dominion Grows Young' in the third part. Lying in the path of the steady southward expansion of the eastern American urban and industrial belt, Virginia is faced with compromising a tradition of conservatism and serenity to take a more active part in the national prosperity.

The book is lavishly illustrated with photographs, many of which are vertical or oblique aerial views. Also there is marked uniformity of map presentation, although it is not consistent through to the end. Seven maps show no scale, and maps on pages 142 and 150 are accompanied by scales which seem incorrect.

J. K. S.

CARTOGRAPHY

Die Kartographie 1943-54 (Eine bibliographische Uebersicht). By HANS-PETER KOSACK and KARL-HEINZ MEINE. 8×11½. Pp. 216. Lahr Schwarzwald: Astra Verlag, 1955. German marks 26.

A new book, the fourth, in the cartographic series edited by Dr Bormann, this is one of the most useful publications in this field to appear in the last few years. Articles on cartography usually appear in a wide variety of publications concerned primarily with geography, photogrammetry or surveying. The problem of gathering sources of information on cartography has hitherto presented a considerable task.

The authors of *Die Kartographie* have collected a very representative list of titles of books, articles and atlases which have appeared since 1943 and grouped them in ten main chapter headings as, for instance, 'General Cartography', 'History of Cartography', 'Allied Disciplines' (e.g. geography, photogrammetry, etc.), 'Government Cartography', 'Civil Cartography', 'Cartography for Schools', 'Applied Cartography', 'Reproduction and Printing', and 'Equipment'. There is also an index of names which, however, could be improved by filling in the omission of co-authors.

J. J. K.

GEOMORPHOLOGY

New Zealand Geomorphology. By C. A. COTTON. 8½×5½. Pp. 281. 16 plates. Wellington: New Zealand University Press, 1955. 42*s*.

Sixteen papers written by Professor Cotton and published in various journals between 1912 and 1925 are brought together in this book. The papers deal primarily with the relationship between landforms and Tertiary and Quaternary earth-movements, both in coastal regions and in the interior of New Zealand, and are a mine of information on landforms due to faulting. Although most of the papers are concerned with quite small areas several deal with the country as a whole. The illustrations include many useful field sketches, block diagrams and photographs, but the maps are not always adequate. Unfortunately owing to the desire to publish the papers in their original form numerous subsequent modifications by the author have had to be inserted, making the book difficult to read in places and in some instances contradicting conclusions reached in the papers as originally written. One wonders if it would have been preferable to re-write completely the sections in need of modification since the originals are available if required in the journals in which they first appeared.

J. B. S.

BIOGEOGRAPHY

Origin and Distribution of the British Flora. By J. R. MATTHEWS. 7½×5. Pp. 176. 6 figs. London: Hutchinson's University Library (Biological Series), 1955. 8*s*. 6*d*.

Although, as Professor Matthews reminds us, there is no sharp distinction between the floristic and ecological aspects of plant geography, the tendency in Britain (in contrast to France) has been for these two aspects to be divorced, largely through the emphasis of the individual worker on the plant species either as an individual or as a member of a group respectively. And, in much of the recent literature on the vegetation of the British Isles, the ecological has certainly overshadowed the complementary floristic approach.

In synthesising so lucidly and in so readable a form the results of work in the field of floristic geography in Britain Professor Matthews has supplied a need long-felt by many of the related sciences. The essential value of his book lies not in the presentation of new material so much as in the exposition and analysis of material

available only in widely scattered sources. Rightly, the major part of this small, but pithy text is concerned with the effects of the Pleistocene glaciation on the pre-glacial flora of Britain, and the climatic and physical vicissitudes which beset the immigration of plants and the final re-establishment of a forest cover in post-glacial times. This is preceded by a chapter in which the differences between the pre- and post-glacial floras are outlined. The last four chapters consider the present composition of the British flora and the problems attendant upon the recognition and classification of the floristic elements of which it is composed; Matthews recognises sixteen elements or groups of geographically related species. The explanation of the origins, migrations and present distribution of these elements still presents many unsolved problems—problems which the ecologist, the geologist, the climatologist and, no less, the geographer may in time help to solve. And these specialists, aware as they must be of the vital clues that plant species can provide in the elucidation of their particular problems, will find in this excellent little book a valuable summary of the not inconsiderable contribution from the botanist to a common field.

J. T.

BIOGRAPHY

Alicella: A Memoir of Alice King Stewart and Ella Christie. By AVERIL STEWART. 8¼×6. Pp. xxiv+311. 10 plates. London: John Murray Ltd, 1955. 21*s.*

This delightful book is the life-story, told in letters to each other, of two devoted sisters born in the 1860's, Ella and Alice Christie of Cowden; the latter married at the age of seventeen Robert King Stewart of Murdostoun. The story is told, and told supremely well, by Lady King Stewart's daughter-in-law.

To older members of the Royal Scottish Geographical Society Miss Christie, famous traveller and explorer of Central Asia at a time when such travel was unique for women, was a familiar and beloved figure. She was for many years a Vice-President and Convener of the Lecture Committee, and was early made a Fellow (an honour which she greatly valued: she once told the reviewer that she always preferred to use the letters F.R.S.G.S. 'Because they really mean you have done something.').

Perhaps the section which will appeal most to readers of this magazine will be the fascinating descriptions of Miss Christie's remarkable travels to such places as Khiva (where she was the first white woman), the borders of Tibet and Japan. Her travels in the latter country enriched Scotland geographically in a very practical sense by the formation (herein described) of the beautiful Japanese garden on the slopes of the Ochils. The letters of both sisters paint a most valuable and quite unpremeditated picture of Scotland's social life from an unusual angle, at a time of extraordinary change. The account will enthral readers of a more hurried and less gracious day.

I. W. H.

The Seasons Return. By JOHN R. ALLAN. 8¼×5¼. Pp. 219. 17 plates. London: Robert Hale Ltd, 1955. 15*s.*

This book consists of thirty-five short articles some of which appeared originally in the *Glasgow Herald.* Some two-thirds of them deal with the author's farm in Buchan and life on it and in north-east Scotland generally, while one-third is concerned with a journey across Canada, and there are single chapters on a farm on the Downs and a Breton village. The articles are written in a lively manner, well-seasoned with humour and reflection and enriched by the author's deep appreciation of the past as well as his intimate knowledge of modern agriculture and its problems. Easy and pleasant to read, they give vivid impressions of the facts and events discussed, and, along with the pictorial illustrations, should prove invaluable in giving townspeople insight into life on a farm and readers in Britain an up-to-date view of Canada.

C. P. S.

GENERAL

Four Archaeological Studies

Rome Beyond the Imperial Frontiers. By Sir Mortimer Wheeler. 7½×5¼. Pp. 224. 20 figs. 30 plates. A Pelican Book. Harmondsworth : Penguin Books Ltd, 1955. 3s. 6d.

Roman Britain. By I. A. Richmond. The Pelican History of England, Volume I. 7½×5¼. Pp. 240. 8 plates. 12 figs. Harmondsworth : Penguin Books Ltd, 1955. 2s 6d.

Roman Roads in Britain : 1. South of the Foss Way—Bristol Channel. By Ivan D. Margary. 10×7⅝. Pp. 253. 16 plates+frontispiece. 11 maps+1 folded end map. London : Phoenix House Ltd, 1955. 42s.

The Problem of the Picts. Edited by F. T. Wainwright. 9¼×6¾. Pp. xi+187. 12 plates. 16 figs. 7 maps. Edinburgh : Thomas Nelson and Sons Ltd, 1955. 21s.

These four volumes, primarily of archaeological interest but coming all together, demand more than the passing comment to which individually they might have been treated in a geographical review. After many years of patient attention to detail, archaeologists in Britain are in a position to summarise and assess ; it is not a coincidence that these volumes have appeared in company. Each surveys a vast amount of patient research, each makes a memorable contribution in its own field, and all are admirably written.

The two Penguin Books are both by scholars of long-established reputation ; inexpensive production at least gives a wonderfully satisfying text-book to the student, and a readable account for those of us with a general interest in the geography of past periods. Professor Richmond, in his eagerness to give of his best, must have found the limits of a small book not a little irksome, but his style never suffers. Sir Mortimer condenses a vast amount of detail in his first chapters on Europe outside the Roman frontier, but with great skill goes on to tell a story of exploration and trading contacts with Africa and the East which cannot but make his later chapters a real contribution to the history of geographic discovery.

The second pair of books are beautifully produced, with excellent illustrations. Mr Margary is well known to archaeologists, and this volume, the first of two, should go far to widen his circle of readers. The first chapter introduces his survey which is the first on a scale corresponding to Condrington's classic on Roman Roads ; the subsequent detailed analysis considers the area south of the Foss Way. Scottish readers will look forward to his study of the North with more particular interest. *The Problem of the Picts* presents a critical survey to date by various writers, each bringing scholarship of no mean order to one aspect of this complex puzzle. Answers are few, but lines of research have been re-opened after being confused by over a century of hot controversy among opinionated disputants. Mr Wainwright, as editor, has laboured the point that the problem is to see clearly what fundamentally is at issue, but he also contributes as an historian. His collaborators give a precise analysis of recent ideas and discoveries ; Mr Stevenson's chapter on Pictish Art is not simple for the uninitiated, but suggests the promise of a book on this topic alone.

Rarely can a reviewer praise with so little qualification four books on closely allied subjects. The topics are not geography, but many of us will be thankful for these surveys, the value of which we can so easily appreciate. H. F.

Historical Geography. By J. B. Mitchell. 7½×5. Pp. xvi+356. 52 figs. London : English Universities Press Ltd. [Teach Yourself Geography], 1954. 10s 6d.

This final contribution to the 'Teach Yourself Geography' series presents historical geography as a necessary foundation to geographical study with the injunction however that it is a subject whose proper pursuit demands a good geographical background. Thus the book, with its emphasis on source material, method

and general guidance, is admirably suited to the professional geographer about to embark on historical studies, though of use also to the amateur wishing to pursue local studies.

Although historical geography is defined in the preface as the isolated study of an area at some past time, the treatment of the themes selected is evolutionary. The peopling of Britain, development of settlements, the changing countryside and changing geography of industry and transport are competently dealt with, in a vigorous style. The orientation in both text and illustrations is towards England and Wales : material concerning Scotland is less reliable and in some cases suspect. A number of the text examples are unnecessarily detailed and long-winded but the diagrams, maps and bibliographical references enhance the value of the book.

B. M. W. T.

The Ordnance Survey Annual Report, 1954-55. 13½×8½. Pp. 5-23. 10 plates. London : Her Majesty's Stationery Office, 1955. 5*s*.

This Report, the first of its kind since 1939, presents a concise but admirable summary of the work and organisation of the Ordnance Survey during the period 1940-55. The Report is strictly factual in character, but the reaction of any reader who is also acquainted with the quality of Ordnance Survey maps must surely be to commend the staff of the Department for the system, drive and skill with which they have effected their work during the past fifteen years. The maps and diagrams supporting the text are clear and informative.

There are, however, probably few readers who will not wish for a fuller report, although it is stated that more detailed information will be supplied on application to the Director General : for example, with reference to Plate VI, for what reason has Devon been selected for the first extensive rural survey on the scale of 1:2,500 ? And looking to the future, would it be possible for a series of separate accounts to be given concerning the work of the different branches of the Survey ?

In conclusion it is pertinent to draw attention to the finance figures (p. 19) ; these reveal that expenditure in 1954-55 was seven times greater than receipts, thus reminding one that Ordnance Survey maps are sold at considerably less than actual cost price.

D. R. M.

ATLASES AND MAPS

A New Map of the World : The Trystan Edwards Homalographic Projection. 40×30. London : B. T. Batsford Ltd, 1953 reprinted 1955. 42*s*. Explanatory Brochure. 5*s*.

The prologue to the brochure that accompanies this map need hardly inform the discerning reader that this is not the work of a professional geographer. The odd result of this experiment is indeed the outcome of a mathematician's preoccupation with statistical values to the considerable detriment of form and proportion.

The projection is certainly new in that it represents land and sea areas correctly upon a rectangular frame, but it is difficult to agree that this map should be widely used in administration and education. The present trend is toward spherical-type world maps rather than the rectangular form, and the unreality of the latter is all too evident in Mr Edwards's projection : areas in low latitudes are extended longitudinally while areas in high latitudes are distended latitudinally out of all recognition. The consequent variations in linear scale which visually falsify many stretches of coastline and frontier surely constitute a basic weakness in a map that specially claims to serve political geography.

This projection is no more than an interesting variation on a well-known theme and it is regrettable that the case presented in the accompanying brochure is in parts both plausible and presumptuous. There is more merit in previously existing projections than is allowed, the majority of map users to-day are not ignorant of the shortcomings of Mercator's Projection, and Mr Edwards's projection certainly fails to give ' an effect of balance and normality '. To claim that Mercator has been

disciplined is surely ridiculous when Mr Edwards himself has tugged at our map in one direction along the equator and at right angles to that direction around the polar circles. D. R. M.

ROYAL SCOTTISH GEOGRAPHICAL SOCIETY

PROCEEDINGS

OBITUARY : We record with regret the death of The Right Hon. Lord Elphinstone, K.T., LL.D., F.R.S.E., President of the Royal Scottish Geographical Society, 1930-34, and Vice-President since 1934, on 28th November 1955.

MEETINGS OF COUNCIL were held on 13th December 1955, and 31st January and 20th March 1956.

AWARDS : The Diploma of Fellowship was awarded to Archibald Richard Burdon Haldane, B.LITT., W.F., 31st January 1956.

ACKNOWLEDGEMENT : The Council thanks those members who so kindly returned copies of *S.G.M.* Vol. 71, No. 3.

LECTURE SESSION 1955-56

The following lectures were delivered :

EDINBURGH. *Usher Hall.*—Miss Freya Stark, C.B.E., on " A Cruise along the South-West Coasts of Asia Minor ", 8th December. Sir Clarmont Skrine, O.B.E., on " Iran Revisited ", 12th January. Professor J. Wreford Watson, M.A., PH.D., F.R.S.C., on " Canada's Opening North ", 9th February. H.E. Chief M. E. R. Okorodudu on " The Western Region of Nigeria ", 8th March.

Central Hall.—D. G. Moir, F.R.S.G.S., on " The 1955 Tour to Austria and Yugoslavia ", 24th November. Miss Elizabeth Stark on " Scottish Women's Himalayan Expedition ", 14th December. Dr A. G. MacGregor, M.C., F.R.S.E., on " Through Australia and New Zealand with a Mining Congress ", 18th January. Rev. J. M. Hall on " Israel—Old and New ", 1st February. Major-General J. C. T. Willis, C.B.E., on " The Ordnance Survey and the Public ", 8th February. Dr J. G. Campbell, F.R.C.V.S., on " A Siamese Interlude ", 15th February. Eric Schacke on " Greenland ", 29th February. Dr Joy Tivy, B.A., B.SC., on " Discovering Galloway ", 14th March.

GLASGOW. *St Andrew's (Grand) Hall.*—Miss Freya Stark, C.B.E., on " A Cruise along the South-West Coasts of Asia Minor ", 9th December. Sir Clarmont Skrine, O.B.E., on " Iran Revisited ", 11th January. Professor J. Wreford Watson, M.A., PH.D., F.R.S.C., on " Canada's Opening North ", 8th February. H.E. Chief M. E. R. Okorodudu on " The Western Region of Nigeria ", 7th March. *St Andrews (Berkeley) Hall.* D. G. Moir, F.R.S.G.S., on " The 1955 Tour to Austria and Yugoslavia ", 30th November. Dr N. Miller, B.SC., F.R.S.E., on " Mountains—European and American ", 18th January. Sidney H. Jones on "A South-Atlantic Cruise ", 22nd February. Major S. F. MacDonald-Lockhart, D.L., J.P., of the Lee on " A Scottish Forester's Visit to Norway ", 13th March.

Royal Philosophical Society's Hall.—Major-General J. C. T. Willis, C.B.E., on " The Ordnance Survey and the Public ", 9th February.

DUNDEE.—*Training College.*—Miss Freya Stark, C.B.E., on " A Cruise along the South-West Coasts of Asia Minor ", 5th December. Ley Kenyon, D.F.C., on " Underwater Exploration ", 9th January. Professor J. Wreford Watson, M.A., PH.D., F.R.S.C., on " Canada's Opening North ", 6th February. Tom Weir on " The High Atlas of Morocco ", 5th March.

ABERDEEN. *Y.M.C.A. Hall.*—Miss Freya Stark on " A Cruise along the South-West Coasts of Asia Minor ", 6th December. Ley Kenyon, D.F.C., on " Underwater Explorations ", 10th January. Professor J. Wreford Watson, M.A., PH.D., F.R.S.C., on " Canada's Opening North ", 7th February. Tom Weir on " The High Atlas of Morocco ", 6th March.